Gas Journal, June 18, 1924. FRENCH GAS CENTENARY NUMBER. Registered as a Newspaper.

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GAS JOURNAL

LIGHT ✦ HEAT ✦ POWER ✦ BYE-PRODUCTS

[Founded in 1849 as the "Journal of Gas Lighting."]

Vol. CLXVI. No. 3188.] LONDON, JUNE 18, 1924. [76th Year. Price 1s.

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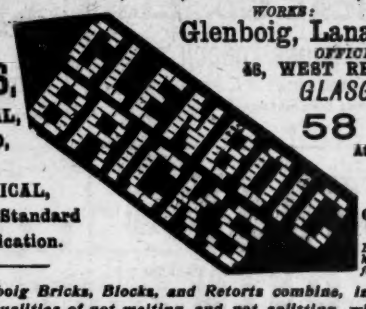

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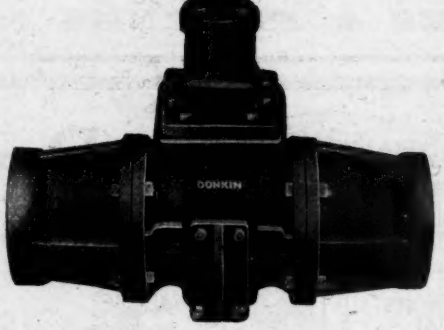

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VOL. CLXVI., No. 3188.] WEDNESDAY, JUNE 18, 1924. [76TH YEAR.

VIVE L'INDUSTRIE DU GAZ EN FRANCE!

TWELVE years or so ago we wrote or said (it does not now matter which) that the centenary of the origin of public gas supply was something worth celebrating with vigour and enthusiasm, inasmuch as it could only happen once. We erred; we should have said so far as Great Britain was concerned. Already (and indeed, to be exact this might have occurred half-a-dozen years ago) we have our interest engaged by another gas-supply centenary. Within a few days, between eighty and ninety British gas engineers will be in Paris joining in the celebrations by our friends in France of their centenary of gas supply and the jubilee of the Société Technique du Gaz—just as on the occasions of both our centenary of gas supply and jubilee of our Institution, representatives of the French gas industry came to this country to congratulate and to rejoice with us, and to wish, in the name of a great friendship and collaboration, conspicuous progress in our industrial affairs and in the promotion of our service to mankind. As we have said, six years ago our French neighbours could have celebrated their centenary of gas supply, but then a long, intensive, cruel war had shaken the land, and victory came to France and her Allies about the same time of the year as one hundred years before the first gas-works were being constructed for the gas supply of Paris. Thus 1918 was not the time for celebrations of anything but victory over fiendish destruction and threatened inhuman tyranny. It is, however, a coincidence that an industry which did so much to supply essential munitions of war during that long terrific struggle had its birth in the country which was the scene of the greatest destruction of life and property almost precisely 100 years before the Armistice. Another coincidence is that exactly to a day six years after this country declared war, the Gas Regulation Act received Royal Assent.

Between the gas industry of this country and that of France, the closest bonds of friendship have ever existed. Those bonds were forged when Murdoch in this country and the genius Lebon in France were working in the same direction, and were laying the foundations to the mighty industries which have, through upwards of a century, been built upon them, to the large benefit of mankind and the progress of greater refinement, utility, and economy in domestic and industrial life. To-day we make no claim for precedence in the invention of public gas supply; all we say is that inauguration of public gas supply in this country anteceded that of France by approximately six years. Rather, while felicitating the gas industry of France upon the attainment of a hundred years and more of service, and the Société Technique du Gaz upon the completion of fifty years of life, we would describe Murdoch and Lebon as allies (only separated geographically) in the cause of human betterment, while giving to Winsor his proper rôle of a piratical adventurer, who sought to enrich himself through the inventive brains of others. There have always been his like in the world; there always will be. But we who know the history of these things can award honour where honour is due; and in our minds and thoughts to-day are united those two great men from whose fertile minds came the inception of the gas industries of these two lands. Others merely followed. Since the days of Murdoch and Lebon, both countries have taken a great part in the making of gas-supply history—each in its own fashion; but in many ways there has been a blending of interests in the cause of development. The French gas industry—Paris herself especially—has given us many men who have done much to add to our scientific knowledge of the many problems connected with carbonization, the combustion of gas, and its applications—in the last-named particularly in the field of lighting, subsequent to the invention of the incandescent mantle. We look back to the eighties and the nineties, and to 1900—the year of the Great Exhibition in Paris—and memory is stirred by the recollections of the part that the men of the French gas industry took in developing, along scientific paths, lighting by the incandescence of mantles. Even then Paris was known, from its (for those days) wonderful public lighting, as "The City of Light." Prior to the beginning of this century, in Great Britain we made considerable advances, more or less empirically, in connection with gas production and supply; there was then very little calling of science to our aid. There was reliance purely on practical experiment and experience; and the marvel is that we made the recorded progress. It was certainly more by sheer good luck than anything else. But in France, scientific men engaged within the industry were busy throwing light upon problems which were mysteries before. If some of their findings have been dislodged by subsequent research, the fact does not by any means defame their efforts and their initial work and discoveries. They gave a good start, and upon what they did their successors have worked and expanded. To-day both countries are applying science to their practices; and by scientific research are seeking still further to develop the systems of carbonization of coal and the utilization of the products. In this there is never-ceasing activity. As in the past, so in the present, French and British gas engineers and chemists are taking a big place as the architects of the fortunes of the industry of gas-supply.

We have been dwelling somewhat on the past. It is pardonable at a time of centenary and jubilee celebration. But we have to congratulate, as we do most heartily, our friends across the Channel on the distinguished and successful part they have taken during the past hundred years, and particularly during the last fifty, in progressive work in the industry. The records are marked by their successes, despite legislative ordinances and restrictions, and notwithstanding the concession system, the conditions of which impose some rigidity upon operations, which at times is found to be rather irksome, and hostile to the most economic service. To-day the "JOURNAL" conveys to the French gas industry and the Société Technique du Gaz messages couched in language expressive of friendship, admiration, and goodwill from the President of the National Gas Council of Great Britain (Mr. D. Milne Watson), Sir Robert Gardiner (who, we believe, holds the record among Britishers for long membership of the Société Technique), and from two eminent administrators of gas supply on the Continent—Sir Charles Jessel, Bart., the Chairman of the Imperial Continental Gas Association, and Mr. Henry E. Jones, President of the European Gas Company, and one of the two outstanding veteran gas engineers in this country, and beloved in France as here. Our other veteran engineer, Mr. Charles Hunt, ardent worker in the technical interests of the gas industry, and long-time student of the history of gas supply and technical practices, has sent us a short appreciation of the brilliant Lebon, and his wishes for the success of the centenary and jubilee celebrations, and for the continued unity of the two nations. These various messages are simply typical of the sentiments and feelings of the men of the British gas industry towards their colleagues and fellow-workers in France; and our French friends will recognize in every passage of the messages a great depth of sincerity

and goodwill. Knowing the illustrious M. Francis Rouland, the President of the Société Technique and of the Centenary Committee, and many of his associates on that body, we realize that these messages will have placed upon them an intrinsic value of no mean order.

Eight days after the date of this publication, the President of the Institution of Gas Engineers (Mr. Samuel Tagg, M.Inst.C.E.) and representative members of the Institution will be travelling to France to share in the centenary and jubilee celebrations. In view of this, publication is being made in this issue of a number of articles which give a considerable amount of historical information as to the foundation and progress of the gas industry in France, together with special articles (in both English and French) on the part that the Imperial Continental Gas Association and the European Gas Company have taken in the gas supply of important cities and towns in France, with a descriptive article on the Landy Works of the Société du Gaz de Paris, to which important station a visit will be paid by those taking part in the celebrations. These by the way have already commenced, through the affixing of a tablet to a building on the site of the first gas-works erected in Paris, and by the opening (on May 31) of an exhibition which, in striking manner, is instructing the public as to the very real importance of the gas industry to the country. A special illustrated article on the exhibition also appears in this issue, and will be informative to the British visitors. To the general public the exhibition exemplifies the great progress that the industry has made in France. It also demonstrates that, though the industry has lived upwards of a hundred years, and has established vast interests and services, discovery maintains its usefulness in service; and it enters upon a second century of work with vigour not only unimpaired, but greater than ever, and fully prepared for a much larger contribution to the home, industrial, and trade life of the community. The technical men who will be visiting the exhibition will find in it much of interest—among numerous other things, a model of a tankless gasholder, and a sample of apparatus for the debenzolizing of gas by the activated carbon process. In mentioning this, we are reminded that recent legislation in France has made obligatory the scrubbing of gas for benzole extraction.

We cannot conclude this article without very sincerely thanking M. P. Mougin, the General Secretary of the Centenary Committee, for the valuable service he has rendered to us in connection with the preparations for the issue of this number, as well as the Société du Gaz de Paris. To all other contributors, we tender our gratitude. As we headed this article, so we end it: "Vive l'Industrie du Gaz en France!"

Two Valuable Flow-of-Gas Tables.

The paper on the "Flow of Gas in Pipes" which Mr. Stephen Lacey, B.Sc., read at the last annual meeting of the Institution of Gas Engineers has gained for him the distinction of the Institution Gold Medal; and there will be unanimous approval of the award. Before the medal is presented, Mr. Lacey has added to the indebtedness of the industry to him by an article which appears in this issue of the "Journal;" and men with practical minds and requirements will especially thank him for this contribution, because it meets their needs. At the time the paper was read in Belfast, we suggested that it was somewhat above the heads of a large number of gas engineers, who desire something in this respect of a simplified nature to be of real service to them. There are but comparatively few gas men who can handle formulæ in connection with gas-flow problems to good practical purpose—not many who know much of how, for example, the coefficient of friction varies with the diameter of pipes, with density, velocity of flow, and viscosity of the fluid. Thus they have difficulty in applying to good purpose the theoretical knowledge which Mr. Lacey, in his usual thorough manner, brought up to date in the paper last year. The contribution, it will be remembered, was especially valuable in that the author threw fresh light, from actual measurements, upon the conditions which must be taken into consideration in utilizing well-known formulæ for the elucidation of the problems that arise in the distribution of gas. In other words, he successfully established "means of correlating experimental data in such a way as to render them available for use in the solution of problems that occur in practice." But what is easy to Mr. Lacey and to other men who have made a close study of the application of theoretical and experimental data to the flow of gas in pipes, is not so easy to all men; and he realizes that what "the practical man really wants are reliable tables which he can use without having to bother about coefficients of friction and viscosity, and other abstractions in which theorists delight."

Therefore, in the article printed in our columns to-day, Mr. Lacey refers in simple way to the problems (and the variables that occur in them) which present themselves in practice. He does not deal with the flow in high-pressure mains, but with the flow of gas in service-pipes and house piping and in low-pressure distributing systems, because it is in these that problems are continually arising, and it is here—great accuracy being seldom necessary—that the need is felt for tables designed to give the required information in the simplest and handiest form. The four variables which arise in the problems are mentioned in the article; and it is pointed out that if a fixed value be selected for one of them, a simple table can be constructed giving the relations between the other three. Mr. Lacey finds it convenient to fix the pressure loss (at $\frac{1}{10}$ in. water gauge), and to let the other variables revolve about it. Explanation is given as to why $\frac{1}{10}$ in. pressure loss is adopted, and also as to how figures are arrived at which are included in the tables. This is an excellent thing, as it will prevent any unnecessary criticism by experts who may find the resulting data not strictly in accord with the results of their own computations. The first table is intended to solve problems arising in connection with the flow of gas in service-pipes and house piping. It presents the flow in cubic feet per hour, corresponding with $\frac{1}{10}$ in. loss of pressure between the ends of lengths of straight pipe varying from 10 to 300 ft. of nominal diameters, ranging from $\frac{1}{4}$ in. to 3 in.—the specific gravity of the gas being taken at 0·50. An accompanying smaller table shows the allowances to be made to the over-all length of a pipe (in feet) for increased resistance introduced by elbows, tees, and bends. A further table is designed for problems arising in low-pressure distribution systems. Here again $\frac{1}{10}$ in. pressure loss has been adopted, and the flow figures apply to lengths of mains (running from 100 to 1000 yards) having internal diameters ranging from 3 to 24 in. The article will be found instructive to all engineers who have to deal with distribution problems, and the figures in the tables will be of great practical value. Mr. Lacey deserves to be heartily thanked for the painstaking work which has evolved these eminently useful data. We are certain they will be referred to and applied daily throughout the industry.

Claims for Gas of Low Calorific Value.

It is abundantly clear that the lessons of certain of the researches of the Gas Investigation Committee have not penetrated completely to the minds of some of the managers of small gas-works. We do not say this out of any disrespect, but simply because the fact is frequently made obvious by published statements. It is a pity, for the lessons would be invaluable in guiding them in their methods of procedure, and would help to stabilize and unify their beliefs. Comment of this kind is justified by what took place at the recent meeting of the Waverley Association, as reported in this issue, when the address of the President (Mr. Alex. M'Donald, of Prestonpans) had the effect of showing that his beliefs in some respects do not square with those of certain of his critics. Perhaps criticism would have been curbed somewhat if more data had been included in the address. It suffered from insufficiency in that respect. But it must be remembered that Prestonpans is a small place, and that the consumption is only 21¼ million c.ft., which is about double the business done in 1917-18—that is to say, in cubic feet, not in therms. But from statements made in the address, Mr. M'Donald would have us believe that the growth in consumption in cubic feet is all good business increase, and not part of it due to the much lower calorific value per cubic foot that he is now supplying than was the case before he adopted complete gasification on the Tully system. From the economic standpoint, such systems are excellent where in small isolated gas-supply areas secondary products have not a ready market, and the provision of coal-carbonization plant and the handling of coal and other materials are expensive. Such circumstances are favourable to complete gasification; and it should do much in helping to supply the gas consumers at a reasonable rate. In his address, Mr. M'Donald did not state the calorific value of the gas, nor the price he was charging the con-

sumers for Tully gas. But it transpired in the discussion that the calorific value of the gas is 375 B.Th.U. per c.ft., and the price 5s. 10d. per 1000 c.ft. This works out to 18·64d. per therm. In the address, it is shown that coal and wages only for Tully gas cost 14·7d. per 1000 c.ft., which is a fraction below 4d. per therm. Between that 4d. and the charge of 18·64d. per therm, or the 14·7d. and the 70d. per 1000 c.ft., there seems to us to be a big covering for all the remaining charges; and it would be interesting to know how this arises. In another part of the address, the President shows that the gas-manufacturing costs (excluding yard work) for April only amounted to 12·1d. per 1000 c.ft., which makes the margin still greater.

This brings us to a ticklish point, which (whether legitimately or not is another matter) controverts all the efficiency lessons of experimental data. The lessons of such data assure us that there is very little efficiency difference in use between a gas of 375 B.Th.U. and one (say) of 550 B.Th.U. Perhaps there is a slight gain in favour of the lower quality of gas owing to the greater ease with which in practice complete combustion can be assured. But it must be flatly said—despite what Mr. M'Donald suggests in his address, and Mr. W. Brown, of Burntisland, in the discussion—that we are not persuaded that a gas of 375 B.Th.U. (Mr. Brown referred to gas of 300-325 B.Th.U.) can do as much work as a gas of 550 B.Th.U. with an equivalent or a less expenditure of cubic feet. If this were true, then we can see (without making a calculation) some of our gas appliances being credited with a 100 p.ct. efficiency—perhaps more—when using Tully gas. Assuming a boiling operation which could be done with a 70 p.ct. efficiency using a cubic foot of 550 B.Th.U. gas, a cubic foot of 375 Tully gas would, according to the President and Mr. Brown, do the same work—about 100 p.ct. efficiency! Assume a gas-fire which gives, with 550 B.Th.U. gas, a 50 p.ct. radiant heat efficiency, and 25 p.ct. of convected heat, the remaining 25 p.ct. passing away in the products of combustion—75 p.ct. of useful heat being given to the room—if the same quantity of heat was transferred to the room by a fire using 375 B.Th.U. Tully gas (the volume of gas being the same), then the flue gases would have to pass away cold, which condition would not meet with the approval of the waste products or that of the users of the fires. Mr. M'Donald and Mr. Brown must really forgive us if we say that there is somewhere a flaw in their arguments. If their consumers do not use more cubic feet of Tully gas than they did beforetimes with coal gas of a much higher calorific value per cubic foot, then they are doing less work, or the higher thermal grade gas was being used extraordinarily inefficiently and the Tully gas with remarkable efficiency, which it is beyond our power to justify. This submission is borne out by the fact that Mr. M'Donald actually gives figures which show a reduced consumption with Tully gas compared with the coal-gas days—in fact, out of a group of consumptions for four manufacturing concerns in 1919 and 1923, one shows upwards of 52 p.ct. reduction, and another a fraction over 54 p.ct. Small reductions are also shown in private accounts "taken at random from the survey books." Mr. M'Donald, however, says that "though all my consumers' accounts are not smaller than they were, I am convinced that, provided the proper burners are used, little or no difference is felt by the consumer." We should be willing to admit this if the comparison were on the therm basis, but we cannot do so on the cubic foot basis, provided the conditions of use correspond.

We will leave the address at that, with the remark that the interests of such gas-making systems as the Tully are not likely to be advanced by statement which is inadequate, and defies proof by scientific and theoretical investigation. There is no denying the usefulness of such plants in certain circumstances and for certain purposes. There is proof of the serviceability in the way Mr. M'Donald is holding his own and making progress in Prestonpans, though faced by electrical competition.

Report of the Institution Council.

A PERUSAL of the Annual Report of the Council of the Institution of Gas Engineers, from which extracts were published in the "JOURNAL" last week, will have impressed several matters upon the minds of members who take a live interest in the activities of the organization. Probably there are some who do not trouble to read the report. If there are, they have little knowledge as to the variety of the work and subjects in which the Institution, as a corporate body, are concerned. The outstanding impression we have derived from the report is as to the extensive amount of work in which the Institution engage in conjunction with other bodies. It was not always so. Time was when the Institution were highly conservative, and resided within an enclosure which allowed no interference with their proceedings, nor was any technical assistance sought outside. Very little, in fact, was heard of the Institution other than at the annual meetings; and then to outsiders there appeared to be a dormant existence until a little liveliness began to manifest itself prior to the next annual meeting. Times change, and we, including the Institution, with them.

Recognition of the value of research and co-operation some few years ago brought into active existence a new policy; and that policy has been largely developed by successive controllers of the functions of the Institution. So much is this so that if the Council find that the Institution are ignored in any matters in which they are concerned as the technical representative body of the gas industry, they are not content to sit still without protest. It is right they should do this both for the protection of the interests of the industry and to preserve its honour and prestige; for the industry to-day occupies no mean place in the system of daily life and in the economic fabric of the country. The Institution have now four representatives upon the Heat Engine and Boiler Trials Committee of the Institution of Civil Engineers—a matter to which the "JOURNAL" directed attention as far back as March 19, when other organizations had been accorded identification with the work, though some of them are not so intimately concerned in it as that dealing technically with gas and coke manufacture and supply. Then there was the by-passing of the industry in connection with the World Power Conference at Wembley. This, too, has been rectified; and July 7 will find a number of papers submitted as a contribution from the gas industry.

But such ignoring of the gas industry is not a normal proceeding. It receives to-day widespread recognition on the part of powerful and serviceable bodies; and by them the co-operation of the industry is both courted and welcomed. This is seen throughout the report of the Council, which indicates the ramifications of the work in which the Institution now engage. As to the work, the most prominent is, of course, that of research in conjunction with the Coal Gas and Fuel Department at the Leeds University, the Society of British Gas Industries, and the British Refractories Association. The operations of the National Illumination Committee of Great Britain are also important; and so are the standardization questions with which the Institution have association. The education scheme is well established; and this is big with significance to the future of the gas industry. Now an inquiry has been inaugurated into the question of the quality of wrought-iron tubing. This, we think, might be extended so as to include an investigation into the respective merits of wrought-iron and steel sheeting for gasholders—a matter referred to in our columns last week (p. 734). The builders of holders would give a large amount of assistance and experience in this regard. We are looking forward with interest to the report of the Gas Investigation Committee Sub-Committee on the exploration of the subject of instituting standard methods for the testing of gas-cookers, in which work Mr. A. Forshaw has been operating as chemist. A standard method of carrying out such tests has long been wanted; and we hope something acceptable will be forthcoming. The Institution have also taken a good part in connection with the British Empire Gas Exhibit; and it will be remembered that they were instrumental in providing a couple of special features for the Public Works, Roads, and Transport Congress towards the end of last year. This is merely an indication of, and not a complete reference to, the manifold activities of the central technical organization of the industry. The indication is a sufficient reflection of the remarkable change that has taken place from the old state of quiescence and limited orbit; it is universally recognized that the Institution is now a potent influence in the work of the industry.

While mentioning the annual report, we join in the sorrow of the Council over the long list of members who during the year have passed hence—most of them bearing names of high distinction in the industry through meritorious technical or administrative labours. At the same time, we congratulate the Institution on having passed the thousand mark in the roll of membership.

The Outside View.

The popularity of the British Empire Exhibition is beyond doubt. Despite the difficulty of transport through the unauthorized tube strike, and the consequent congested state of omnibuses, one-third of a million people found their way to the exhibition on Whit Monday. The fact of the matter is, people will get there, no matter at what personal inconvenience. Wherever one goes, the question is "Have you been to Wembley yet?" If the answer is in the negative, it is almost certain that it will be followed by an intimation as to prospective plans for a visit. If it is in the affirmative, another visit is in view. The Gas Exhibit continues to receive its full share of attention; and complimentary testimony still flows in. We have before us a letter from a distant place in the provinces, which incorporates this extract from the Editor of one of the local papers: "Our own representative at Wembley expressed the opinion that the Gas Exhibit was one of the most dignified forms of advertisement that he had ever seen." This is absolutely voluntary testimony. There is, in fact, no need for the Exhibit Committee to solicit testimonials; they come in freely. Another piece of information from a friend is that his doctor was greatly impressed by the exhibit; while another totally disinterested person states that "the Gas Exhibit is quite one of the 'star' turns at Wembley." We reiterate what we have said before, that we would rather have these outside opinions than any unanimous view from the men of the gas industry, because these external opinions reflect the achievement of a great purpose.

Smokeless Cities.

The low-temperature carbonizing plant which is being constructed at Nottingham is having associated with it a campaign for the promotion of smokeless cities by the use of coke produced by that system. It is said that Nottingham is hoping to be the first smokeless city; and Mr. George H. Roberts has written to the "Manchester Guardian" advising the people of Manchester to emulate the enterprise of the citizens of Nottingham. Many other cities and towns will doubtless be urged to take the same course.

Proposed Municipal Trading in Coal.

The Coal Distributors' Information Department (which we suppose represents the retail coal merchants) understand that Mr. Shinwell, the Secretary for Mines, is preparing a report for Parliament advising the sale of coal, so far as possible, through municipalities and co-operative societies. The coal distributors are naturally and properly chary of comment upon the report until its precise terms are available for examination. But they say their general attitude may be, with one proviso, summed up in the phrase "Let him get on with it." The proviso is that there shall be no subsidizing of a municipal coal merchanting business from the general rates, and that the accounts shall be properly kept and scrupulously isolated, as in a commercial enterprise. There is nothing new in the suggestion that either local authorities or co-operative societies should deal in coal. The coal distributors are confident that they have nothing to fear from such competition (even though not subject to the ordinary taxation of a commercial firm) if all expenses properly chargeable against the enterprise are paid out of the receipts from the sale of coal, and not from the sale of gas, or the proceeds of a general rate.

What the Miners Want.

The Minister of Mines (Mr. Shinwell) repudiates the general belief that what the miners mean by nationalization is "The mines for the miners." According to this authority, that is a false conception, sedulously circulated for political capital purposes. The miners, he asserts, do not want the mines; what they desire is that the mines should be properly and efficiently managed on behalf of the whole of the people. For this purpose, they wish to enlist all the available intellect, capacity, and energy associated with the industry. This is all very nice; but it does not exactly fit in with some of the declarations of the miners' leaders as to securing what they regard as the full pound of flesh when the blessed day arrives which will see the nationalization of the coal mines. Another thing that Mr. Shinwell made clear was that the Government do not intend to allow the question of retail coal prices to remain in the present position.

OBITUARY.

It is with regret we have to record the death of Mr. George William Mason, Secretary of Messrs. Settle, Speakman, and Co., Ltd., colliery proprietors and coal factors, of Alsager, London, Liverpool, Manchester, Birmingham, and Queenborough. Mr. Mason, who had been Secretary to the firm since its formation, passed away at his residence—Sidmouth Avenue, Newcastle-under-Lyme, Staffs., on Saturday morning, the 7th inst. He had been in failing health for some little time, but his death came as a great shock to his many friends and acquaintances in local colliery circles.

ELECTRICITY SUPPLY MEMORANDA.

We admire Mr. L. L. Robinson, the Borough Electrical Engineer of Hackney. He ought not to have been an Engineer; he is one of the best electricity salesmen—a sort of super-salesman—that the electricity industry has produced.

When a Chief Speaks.

But he can say nice things and nasty things in the same breath; he can contradict himself; and he can display a good finesse in just making slight revelation of points highly important to consumers, and then say no more about them! He has contributed to the "Electrical Review" an article headed "Out for the Domestic Business." There is something pugnacious about the title; but let it pass. Here is an instance of illogical language and statement by Mr. Robinson: "It is bad salesmanship to run down your rival's goods. I don't run down gas. In my area I believe the gas is very good gas." Previously Mr. Robinson had been saying: "Gas is merely the crude transport vehicle of energy, which leaves the wasteful and filthy process of combustion to be carried on more or less successfully, and at best inefficiently, in the consumer's apparatus." "I don't run down gas!" Now why does an engineer, presumably a scientifically trained one, write such stupid things about a competitor? Gas, as he must know, is a refined product of coal, and in itself contains a larger proportion of the heat energy of coal than the electricity derived from a similar quantity; and, *plus* the gaseous heat energy, we have that supplied in the form of smokeless coke, the tar with its store of valuable derivatives, the sulphate of ammonia, the sulphur, and much else—all with highly valuable applications. We ask Mr. Robinson, as a scientifically trained man, to say candidly whether this is not a more efficient process than the production of electricity? In putting this question, we will say with equal frankness—knowing its indispensability as well as we know the indispensability of the products of coal carbonization—that the world without electricity would not be the same as it is now. Then having in view the value of combustion to man, it would be highly interesting to know why this scientifically trained engineer refers to the combustion of gas as "a wasteful and filthy process." It would also add to knowledge and perhaps to the gaiety of controversy if, instead of postulating about the inefficiency of gas in the consumers' appliances, he would illustrate the point by actual facts regarding efficiency and cost for doing an equal amount of work. We see that for heating purposes he rather favours 1d. per unit—that is 3420 B.Th.U.; while at 8d. per therm 12,500 B.Th.U. are supplied by gas for 1d. This will serve as a basis upon which Mr. Robinson can discuss relative efficiency and economy from the point of view of the consumer—he having chosen the ground by his reference to "wasteful and filthy process," and the statement "at best inefficiently in the consumer's apparatus." Messrs. Lyons & Co., as expert caterers, adopted gas for the immense work they are doing at the British Empire Exhibition.

Assertions and Some Questions.

The importance of the domestic business is stressed by Mr. Robinson on account of its "off-peak" character, "even when supplied at very cheap prices, which are fully competitive with gas." We note the word "very;" and there are electrical engineers who know that even at "very cheap prices" for most domestic purposes for which either agent can be used, electricity is not competitive with gas regarded from the points of view of economy for equal work, nor in respect of operating efficiency, including time saving. The domestic load is recognized as of great importance by gas undertakings. But Mr. Robinson looks upon this recognition and the operations of electricity purveyors to secure a share of it as the causes of a "violent opposition," which he thinks has been "too explosive." We have not noticed that the opposition has been "violent" or "explosive." The expressions suggest that the person who uses them has got some extravagant notions in his head, and examines his competitor's operations with a high-power magnifying glass. Now we are confident that Mr. Robinson would be the very first to say that those responsible for a trading undertaking, with a new competitor in the field—however inefficient—would be silly asses if they did not at once act upon the defensive. We can see his mouth framing the words. But because the gas people do this—because they do not want to lose even a single customer to one-sided statement, or to assertions as to a "wasteful and filthy process" and "at best inefficient"—well, in the view of this

delightfully decorous engineer who proclaims that "it is bad salesmanship to run down your rival's goods" and "I don't run down gas," the action is "violent" and "explosive." Following on, we have another question to ask Mr. Robinson. He says: "The first things we are up against are the appalling ignorance of the public in connection with what to us are the commonplace uses of electricity; the natural British conservatism, which seems to be ingrained even deeper in the women than the men; and the bogey which we have to some extent created ourselves by charging too much for supplies which cost less than we thought they did; and by clever persistent reiteration by the gas companies of the phrase —'Electricity is expensive.'" Now the further question we wish to ask is how Mr. Robinson accounts for the fact, if his first two submissions are correct as to the ignorance and conservatism of the public, that the gas-cooker jumped into such immediate popularity until now there are some 5¼ million gas-cookers and grillers in use in Great Britain, and gas-fires to a number of which count has not been made? Why is it the experience has not been repeated in the case of electric-cookers? The causes are not to be found in Mr. Robinson's article. They are deeper down than is divulged by ordinary electrical platitude.

Strenuous Efforts Needed.

There is much in the article by Mr. Robinson as to business-getting methods, which could just as well be printed in our columns for gas salesmen as in those of an electrical contemporary. But what surprises us is the spacious field of method that this exponent of business-getting advises as necessary for electricity to make headway—electricity with all its boasted virtues. Yet gas utilization expands and expands for domestic use; and there is confidence that Mr. Robinson will not be prepared to associate himself with those electrical simpletons who trample on fact, and say the contrary is the case. Well, now, the declared superiority of electricity notwithstanding, according to the advice and instruction from Hackney, much has to be done to induce people to give credence to the gospel of electrification in the kitchen. There must be concentration upon the education of the public—not only the adults; the children must be taught in the schools. Local exhibitions should follow the "E.D.A." effort at Wembley. Installations on free trial for three months should be offered. The electrical representatives should be provided with an album, with a photograph of a cooker installation on one page and on the facing one a testimonial from the user. Local newspaper advertising is very important. Each local newspaper should have revenue from the publicity fund of the undertaking. Presumably in respect of this local advertising, the advice is given: "Don't be afraid of hitting out at your competitors. You may be sure that, if they are not hitting you in the face, they are hitting you in the back somewhere." This charge of cowardly hitting in the back shows that Mr. Robinson's ideas of good sportmanship in trade rivalry are neither courteous nor of a high level. This is emphasized by the advice given in one of his advertisements—"Keep clear of dirt, fumes, and poison." This requires a little explanation, as well as some information as to why the advertisement—coming from such a model competitor, who avows "I don't run down gas"—did not speak of the insidious character of electricity for fire-raising, and of its electrocuting capacity at the ordinary supply voltages. However, to proceed, programmes for local events are advocated as good opportunities for advertisements. The "E.D.A." leaflets should be distributed with the quarterly accounts. Every envelope could bear a "stickyback" reminding the consignee of the existence of the electrical service. Every motor lorry and every jointer's truck should carry a message to the public. Every feeder pillar and sand bin could carry a hint on an enamelled plaque of the service which could be rendered by electricity. Topical lantern slides at the theatres and kinemas should be used considerably. "Many other tricks of publicity could be mentioned." Free popular lectures organized and run with the assistance and co-operation of the local Chamber of Commerce are very effective, and always obtain a good Press. Enthusiastic consumers should be invited to give lectures and demonstrations. Articles should be contributed to the local papers, and friendly letters to consumers preserve a "personal attention" kind of atmosphere. A real showroom and demonstration hall are needed. To publicity Mr. Robinson allocates 1 p.ct. of revenue. By all this, one is struck with the enormous amount of big-drum beating electricity requires to get a move on in domestic electrification! The gaudily clothed merits of electricity and the cloaking of gas with fumes and poisons are not sufficient to realize a quick success for the efforts to stop the ever-increasing rotundity of the domestic gas trading of the rival industry.

Low Price Must Supplement Other Effort.

Extensive as those methods are, they need supplementing. This is where there is intensified acknowledgment that the attributed virtues of electricity are insufficient qualities standing alone. There must be a "suitable" tariff. Rolls-Royce cars command heavy prices, and a good business is done in them. But the boasted "Rolls-Royce" merits of electricity can only be sold at a very low figure for cooking and heating. A small margin above the cost of fuel per unit sold is advocated; all the other charges can be borne by the users of energy for other purposes, which is robbing Peter to let Paul off lightly. No other commodity of which we know has to be treated in this fashion. Coal with all its disadvantages is still retailed at very high prices. Why is this when electricity is available? This low-price attitude of electricians is taken for a very good reason. It is the only way to obtain business in this direction, which is excellent testimony to the importance of cost as a first-place factor. If the cost of energy exceeds 1d. per unit, Mr. Robinson would hesitate to tackle cooking and heating at all, because 1d. per unit, he says, is comfortably competitive with gas. Is it? Why do not the public prove that it is so? Why is the domestic heating business of the gas industry expanding so rapidly at present prices? Mr. Robinson gives a reason why he would still charge 1d. if his fuel costs were not in excess of ½d. It is that it is much easier to get business if the hire charges for electrical apparatus are not in excess of the charges made for gas apparatus of equivalent capacity. With fuel costs not in excess of ½d. per unit, and the current sold at 1d., the undertaking could afford to lend cookers for nothing, and still be in pocket on the whole transaction. "Clever, but not convincing," will be the verdict of most men who know that machinery and plant cannot be run without depreciation, and that fuel costs are not the only ones pertaining to generation, distribution, clerical work, &c. Mr. Robinson's contentions would require very close investigation before commending themselves to competent financial authorities. Then to keep down costs, the consumers must make a study of how to economize. They must use quick-boiling kettles. Vegetables must be put on early to avoid the use of unnecessary quantities of water. For instance, when boiling an egg, there is no need to drown it. Again a grilled egg is much nicer than a poached or fried egg, and is cooked in half the time. In other words, with electricity, people must not be so extravagant with the heat units as they are with the much cheaper gas ones. They must adopt scrupulously fine methods of operation, in addition to securing the energy at a shadow of expense above fuel cost. What a pretty tale Mr. Robinson has told! It is by no means a clever one; he has revealed too much.

FLOW OF GAS IN PIPES.

By STEPHEN LACEY, B.Sc.

In my paper on the "Flow of Gas in Pipes," presented to the Institution of Gas Engineers last year, I attempted to bring the theoretical treatment of the subject up to date, and to establish means of correlating experimental data in such a way as to render it available for use in the solution of problems that occur in practice. Some of my friends said that this sort of thing may be all very well, but what the practical man really wants are reliable tables that he can use without having to bother about coefficients of friction and viscosity and other abstractions in which theorists delight. With this view I cordially agreed, and promised to do something about it. So much in explanation of these notes, which it is hoped will serve, at long last, to redeem my promise.

The problems that present themselves in practice may be conveniently divided into three classes:

(*a*) Flow in service pipes and house piping.
(*b*) Flow in mains in low-pressure distributing systems.
(*c*) Flow in high-pressure mains.

The problems under (*c*) do not occur every day, and those who have to deal with them are generally prepared to spend some little time in reference to text books and in calculation. Problems in classes (*a*) and (*b*), however, are continually arising; and it is here, where great accuracy is seldom necessary, that the need is felt for tables designed to give the required information in the simplest possible way.

For a particular gas there are four variables in all such problems:

(1) Loss of pressure between the ends of the pipe after correction has been made for difference of altitude.
(2) The length of the pipe.
(3) The diameter of the pipe.
(4) The rate of flow corresponding to 1, 2, and 3.

If a fixed value be selected for one of the four variables, a simple table can be constructed giving the relations between the other three. I have found it convenient to fix the pressure loss (at $\frac{1}{10}$ in. water gauge) and let the other variables revolve about this.

Table I., which is based on the results of the experiments expressed graphically on Plate I. of "Flow of Gas in Pipes," is intended to be used for solving problems in class (*a*).

TABLE I.—*Flows in C.Ft. per Hour Corresponding with $\frac{1}{10}$ in. Loss of Pressure between the Ends of various Lengths of Straight Pipe of Nominal Diameters ranging from $\frac{1}{8}$ in. to 3 in.*

Sp. Gr. of gas, 0·50. Actual diameters are given in "Flow of Gas in Pipes" Inst. Proc. Gas Eng. 1923.

Length of Pipe. Ft.	Nominal Diameter of Pipe (Inches).									
	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{3}{4}$	1	1¼	1½	2	3
10	3	14	33	72	130	240	..	..	..	..
20	..	7	18	49	88	165	340	530	..	..
30	..	..	12	38	70	130	270	420	890	..
40	..	..	..	29	60	110	235	360	770	2240
50	..	..	..	23	52	98	210	320	680	1980
60	..	..	..	..	47	89	190	290	620	1800
70	..	..	..	..	40	81	170	260	560	1630
80	..	..	..	..	..	75	160	240	520	1510
90	..	..	..	..	..	71	150	230	490	1420
100	..	..	..	..	..	..	140	215	460	1340
150	..	..	..	..	..	..	110	170	370	1070
200	..	..	..	..	..	..	96	150	310	900
250	..	..	..	..	..	..	..	130	280	795
300	..	..	..	..	..	..	..	115	250	710

Bends and tees can be allowed for by adding to the overall net length of pipe the lengths given in the table below. The gross length thus obtained is the length given in the table above.

Nominal Diameter of Pipe. Inches.	Addition to be made to Overall Length of a Pipe (in feet) for Increased Resistance Introduced by Fittings.		
	Elbows.	Tees.	90° Bends.
¼ to 1 . . .	2	2	1
1¼ to 1½ . . .	3	3	1½
2	5	5	2
3	8	8	3

The following considerations explain why it has been found convenient to relate all the figures in the table to a standard pressure loss of one tenth. As a general rule the maximum pressure difference between a main and any gas-consuming appliance supplied from it should not exceed (say) five tenths, which may be allocated thus—one tenth to the service, two tenths to the meter, and two tenths to the piping between the meter and the gas-consuming appliance.

In ordinary house supplies the difference in altitude* between the main and the gas-appliance farthest from it will increase by one or two tenths the pressure available for producing flow in the pipes. Thus, in general, there will be three or four tenths available for overcoming the frictional resistances of the pipes from the meter; and as the pipe between the meter and the farthest gas-consuming appliance is usually divided into three or four sections of different diameters, it will be seen that one tenth loss can be allowed in each section at the maximum rate of flow in that section.

In practice the length of a particular section of pipe is generally known; and it is required to find the diameter corresponding to a maximum rate of flow, which depends upon the appliance or appliances supplied through it. Where, as explained above, a loss of pressure of one tenth is appropriate, the table can be used directly for finding the diameter, or, alternatively, if the diameter is known, for finding the corresponding rate of flow.

In some circumstances, however, a greater loss of pressure than one-tenth may be allowable (*e.g.*, in a pipe from the outlet of a meter supplying a geyser only). The necessary correction can then be made in one of the two following ways:

(1) Divide the gross length of the pipe (*i.e.*, the net length *plus* additions for bends, &c.) by the allowable loss of pressure in tenths, and thus obtain the gross length corresponding to the standard loss of one tenth. This length can then be used in the table.

For example: Required to find the rate of flow in a 1-in. pipe 40 ft. in length (gross) with a pressure loss of four tenths.

$$\frac{40}{4} = 10$$

Flow in table corresponding to 1-in. pipe 10 ft. long = 240 c.ft. per hour.

(2) Alternatively, the gross length can be applied direct to the table, and the following corrections made to the rates of flow found from the table.

For a loss of pressure of 2 tenths add 50 p.ct. to flows in table.
" " " " 3 tenths add 80 p.ct. " "
" " " " 4 tenths add 120 p.ct. " "

The results obtained will be only approximately correct, but near enough for practical purposes.

Where the Sp. Gr. varies from 0·50, the necessary correction to the rate of flow as given in the table can be simply made by adding 1 p.ct. for every 0·01 below the standard gravity, and *vice versa*. Thus, if the Sp. Gr. is 0·45, add 5 p.ct. to the flow as found from the table; if 0·55, deduct 5 p.ct.

The underlining of certain figures in the table is intended to indicate the greatest length of pipe of a particular diameter which, as a general rule, it has been found desirable in practice to lay. Thus, the underlined rate of flow (38) for a ½-in. pipe corresponds with a gross length of 30 ft.

The following table, constructed on the same lines as the one above, has been designed for problems coming in class (b); the same standard loss of pressure (one tenth) has been adopted, but the lengths are given in yards instead of feet.

TABLE II.—*Flows in C.Ft. per Hour Corresponding with One-Tenth of an Inch Loss of Pressure between the Ends of Various Lengths of Main of Internal Diameters ranging from 3 in. to 24 in. Sp. Gr. of Gas = 0·50.*

Size of Main.	3	4	6	8	10	12	14	16	18	24
Length in Yards.										
100	700	1500	4400	9400	17,000	27,000	41,000	58,000	78,000	166,000
200	500	1050	3000	6500	12,000	19,000	28,000	40,000	55,000	118,000
300	400	800	2400	5200	9,000	15,000	23,000	32,000	43,000	92,000
400	350	700	2100	4400	8,000	13,000	19,000	27,000	37,000	79,000
500	300	600	1800	3900	7,000	11,500	17,000	24,000	33,000	70,000
600	260	560	1650	3500	6,300	10,400	15,500	22,000	30,000	63,000
700	240	520	1500	3200	5,900	9,500	14,300	20,000	27,000	58,000
800	..	490	1400	3000	5,500	8,800	13,300	18,800	25,000	54,500
900	..	460	1300	2800	5,100	8,300	12,400	17,500	24,000	51,000
1000	..	430	1250	2650	4,800	7,800	11,700	16,500	22,600	48,000

The above table is based upon the formula $Q = 188\sqrt{\frac{hd^5}{\zeta 8L}}$; the values of the coefficient of fraction ζ used corresponding to the higher values given in the table on p. 292 of Proc. Inst Gas Eng., 1923. The values are sufficiently high to allow for any normal number of bends in the pipe line and for normal roughening of the internal surface of the pipes by corrosion.

Corrections can be made for variations in the pressure loss from the standard one tenth, or for variations in the Sp. Gr. from the standard 0·50, in the way already described in reference to the table for pipes of smaller diameter.

* A difference of altitude of 14 ft. corresponds to one-tenth difference of pressure when the Sp. Gr. of the gas = 0·50. When the Sp. Gr. = 0·46, the corresponding height is 13 ft. When the Sp. Gr. = 0·54, the height = 15 ft.

BRITISH EMPIRE EXHIBITION NOTES.

With the Whitsuntide Holidays, Wembley may be said to have fully "come into its own." Every day is adding something further to the attractiveness of the Exhibition, and all that is now wanted is a good spell of fine summer weather. During the whole of last week the attendances were remarkably good, and both buildings and grounds presented a scene of animation which will be long remembered by those who were present. From now onwards it may be taken for granted that the daily number of visitors will continue to grow, at any rate until the autumn, so that those who have been waiting until everything was complete have missed the chance which presented itself during the first few weeks of a leisurely and uninterrupted inspection of everything among the marvellous exhibits which might most appeal to them. Now the quiet calm of the earlier days is replaced everywhere by animated bustle, and Wembley has just what was needed to make it a huge success—life.

THE GAS EXHIBIT.

On Bank Holiday the Exhibition was so heavily patronized that there was a constant stream of visitors passing through the Gas Exhibit; and though it was essentially a "holiday crowd," it is gratifying to find that a number of inquiries were made by visitors regarding the display. No surer proof than this could be adduced of the public appeal that the Exhibit makes. A small but well conceived addition is noted in the Rest Lounge, where, in connection with the Seven Ages of Women, there are now to be seen printed cards in gilt frames, giving short "talks" on gas germane to the various tableaux. These, of course, serve further to emphasize the uses of gas in the different circumstances depicted.

THE EVOLUTION AND HISTORY OF LIGHTING.

Also in the Rest Lounge of the Gas Exhibit, there has been made a wonderfully interesting addition to the Historical Section, in the form of two large show cases, one of which is filled with a valuable collection of objects illustrating the evolution and history of lighting. These have been very kindly loaned to the Committee by the Wellcome Historical Medical Museum, of Wigmore Street, London, W. The use of oil and wick has come down to us from the time of the early Egyptians, at least 3000 years before the Christian Era. In the early Greek and Roman times, the lamp was still used for illuminating purposes. In castles and other large buildings in the feudal period, the torch was mainly employed for illumination, while in smaller apartments the candle took its place. The use of candles made of fat or wax goes back to very early times, and two unique specimens are shown of ancient wax candles of the sixteenth century, one of which is dated 1552. Candles were made of various fatty substances, and a curious specimen is exhibited made of oil seeds threaded on a central wick. A candlestick with tinder box in its base was thought to be a very ingenious contrivance when it was invented in 1827. The rushlight was a common method of lighting in cottages and small dwellings during the seventeenth and

eighteenth centuries. In the nineteenth century the float and wick was introduced, and was the predecessor of the nightlight. Now for more than a hundred years the world has enjoyed the benefits of coal gas as an illuminant.

HISTORY OF IGNITION AND EVOLUTION OF THE MATCH.

The second of the two Wellcome Historical Medical Museum show cases which have now been placed in the Rest Lounge of the Gas Exhibit contains an equally valuable collection of objects illustrating the history of ignition and the evolution of the match. The earliest method of producing ignition was probably the fire-stick, used by primitive man, and still employed by barbaric races to-day. The use of the hands in promoting the necessary friction was succeeded by the bow, which was found to give more rapid results. The discovery that sparks could be obtained by striking a piece of metal with flint probably dates from the Iron Age; and with the use of suitable tinder, it became the method of obtaining fire throughout the world. Tinder played an important part in the operation, and specimens are shown of various materials employed in different countries. Ignitable sticks are said to have been used in France in the fourteenth century, but it was not until 1805 that the first attempt was made to employ chemical agency for the production of fire, when Chancel, of Paris, invented his apparatus, which consisted of splinters of wood, tipped with a mixture of sulphur, potassium chlorate, and sugar, which would ignite when brought in contact with sulphuric acid. Phosphorus was used in the making of matches in 1809, but the first really practical friction match was invented by John Walker, a chemist of Stockton-on-Tees, in 1827. It consisted of a thin stick of wood coated with sulphur, and tipped with a mixture of antimony sulphide, potassium chlorate, and gum, which ignited on being rubbed on sand paper. The phosphorus friction match was first made on a commercial scale in 1833, and the safety match, in which the phosphorus was transferred to the side of the box, about 25 years later.

SPECIAL VISITS.

A number of Directors of Gas Companies and Committees who have been responsible for substantial contributions to the display are taking the opportunity of visiting the Gas Exhibit officially as Boards and Committees, and they are expressing generally great satisfaction at the appeal that the industry is making from the public point of view, as well as commenting very favourably on the wonderful display from the gas industry's side.

On Friday evening the Gas Exhibit was visited by the members of the Regent Advertising Club, which is composed of rising journalists and advertising men and women, who are studying the whole science of publicity. They appeared to be greatly impressed by this remarkable co-operative effort. The function was educative in the best sense of the word, as sowing seeds which will undoubtedly be of benefit to the industry in days to come, as well as in the immediate future. The Committee are to be congratulated upon taking this broad view of their opportunities, because nothing but gain can accrue to gas from a wide dissemination of knowledge concerning it.

ALUMINIUM WARE FOR GAS COOKING.

One of the stands in the Domestic Utilities Section of the Palace of Industries is occupied by Messrs. Bulpitt and Sons, Ltd., of Swansea Works, Birmingham. They make a large and comprehensive display of aluminium cookery utensils, of which a considerable quantity is supplied to gas undertakings throughout the country. Messrs. Bulpitt are also showing their utensils in the Gas Exhibit. Their speciality is "Swan" brand aluminium ware. This metal, it is claimed, is economical to use, inasmuch as heat penetrates through an aluminium saucepan far more quickly than it does through an iron or an enamelled one. It is, of course, very easy to keep clean, and compares favourably in cost with other materials. "Swan" brand is made in various designs and qualities to suit all needs, but the purity of the metal is the same in every case.

GAS SUPPLY AT THE EXHIBITION.

At a conference of Engineering Societies, of which the Society of Engineers was one, held in one of the Conference Halls last Friday week, four short papers were read and discussed—including "Sanitation and Water and Gas Supply at the British Empire Exhibition," by Mr. R. Freeman-Matthews, A.M.S.E., Resident Consulting Engineer at the Exhibition on the subjects named. In the final section of his paper, the author said that the main gas supply consists of two feeds, which enter the Exhibition at the meter house behind New Zealand, on the west side. The supply of gas is directly under the control of the Brentford Gas Company, who have brought two 18-in. mains up to the Exhibition boundary, a distance of some seven miles. One of these mains comes from Brentford, and the other from Harrow. The two main meters are "slightly larger than one would use in a private house;" the bigger of the two being about 12 ft. square, and weighing, when containing its full requirement of water, some 60 tons. The weight of the other one is about 50 tons. Each is capable of passing approximately 1 million c.ft. of gas in twenty-four hours. The consumption at the present moment is from 500,000 c.ft. to 600,000 c.ft. daily; and the pressure varies between 45-10ths and 50-10ths. There are two 12-in. mains from this meter house, which run in an easterly direction, and loop-up on the eastern area. The total length of mains and services inside the Exhibition grounds is about 10 miles.

THE AMUSEMENT AREA AND BUILDINGS.

Continuing, Mr. Freeman-Matthews pointed out that all the outside lighting in the Amusement Park (as "JOURNAL" readers are already aware) is done by gas. The main roads have standards on each side at about 60 ft. apart, and the lamps are 1650 c p. ones. "It is," he declared, "light as day at night, and helps people to find their loose change for the many pleasures that are to be obtained in this part of the Exhibition." Inside the two main buildings 6 and 8 in. mains have been run, from which have been taken all subsidiary services for exhibitors, a great many of whom use gas for power, heating, &c. When crossing concrete bridges in the eastern area, Mannesmann steel tube has been used, the pipes being exposed on the sides of the bridges. They are all, of course, wrapped and coated, for protection against weather. There is a 4-in. Mannesmann tube main round the whole of the Stadium, slung to the underside of the stands. This is connected by a 6 in. pipe from the main Exhibition supply. This is to feed the restaurants, buffets, bars, &c. There are syphons at different low points over the system; and these are all pumped out regularly each week, and from which a considerable amount of water is removed owing to condensation in the pipes.

THE SUPPLY MOST SATISFACTORY.

"It is," said the author, "satisfactory to know that, up to the present, the gas supply has been most satisfactory, and no complaints to mention have been made. It speaks well for the work of the contractors. After the mains had all been pumped out, and then charged with gas, the main metres held for some hours without the slightest vestige of movement. This is the more commendable when it is known that some of the mains under the Palace of Industry had to be laid under a concrete floor in a gallery about 4 ft. high and 4 ft. wide, there being no duct through the northern portion of the building. It could not have been a pleasant job, running in the lead joints under these conditions. The foreman who superintended this work was presented to the King on the opening day."

GAS IN THE RESTAURANTS.

All restaurants use gas for cooking, and in some of the larger ones there are 500-light meters, which are over 6 ft. in height, and pass more than 3000 c.ft. of gas an hour. The large grill in the Palace of Industry has two of these 500-light meters, one having been found insufficient. Over 6000 c.ft. per hour is used for this restaurant. Over a thousand people can be accommodated at one time. The seating capacity of all restaurants, cafés, &c., is about 30,000; and it can be imagined that much extra work was necessitated in arranging for the services of these places.

STANTON SPUN PIPE.

The point in Mr. Freeman-Matthews' paper to which most reference was made in the subsequent discussion was that, besides using ordinary cast-iron pipes for the mains, there have been laid Stanton "De Lavaud" spun pipes, "which are one-third lighter, and cheaper, and have proved quite satisfactory." One member said it would be interesting to have some further information as to how these worked out in practice. Was there any difference in the discharging capacity of them; were they smoother; and did they actually work out cheaper? Mr. Freeman-Matthews replied that they began by using ordinary cast-iron pipe for gas, but then the question arose as to being able to get miles of pipes in quickly, and the contractors sent their representatives down to the Stanton Works. He witnessed the manufacture of the spun pipe, and saw that it answered to the specification. It came up to all requirements in regard to resisting pressure, and it was a very smooth pipe. Probably two-thirds of the gas-mains were spun pipe, but they had not used it for water or in connection with any drainage, so he could not speak as to its suitability for these purposes. The only fault he had to find with spun pipe was that it was difficult to cut, though it could be drilled easily up to (say) 2 in. It was, of course, much lighter than cast iron, and buying pipes by weight it became cheaper. It was all socket and spigot, and no special jointing material was employed. The pipes were coated, but they had not been in long enough for him to say how they would stand up against corrosion. One member expressed the opinion that there should be no real difficulty in making spun pipes that could be cut. Answering further questions, the author said there was a beautiful finish on the inside of these pipes, which were tested up to a pressure of 600 lbs.

"Ever since the Exhibition has been opened," concluded Mr. Freeman-Matthews, "the gas question has been finished. It was one of the things completeded on opening day; in fact, a considerable number of the restaurants used gas a month before."

PETROL ENGINES FOR IRRIGATION.

Another of the papers read at the recent conference of Engineering Societies was by Mr. A. Honeysett, Assoc.M.Inst.C.E., who dealt with the subject of "Pumping in Relation to Irrigation." Where cultivators need to raise water to a higher level, in out-of-the-way places, he recommended a centrifugal pump driven by a petrol or paraffin motor—of good quality. Even a motor-cycle engine could be employed for transmitting as little as 1 H.P. to a 2 in. or 3 in. centrifugal pump, and this could be made to lift an amount of water reaching 50,000 gallons a day, and deliver it against such a head as is likely to be required for the irrigation of flat land. The cost of such a unit delivered at some remote spot would be about £100, and (say) £50 more might be allowed

for laying a pipe to connect it with the highest spot on the estate. The capital cost would thus be about £150, involving a charge for interest and amortization of (say) £10 10s. a year. The maintenance would add some £5, and the cost of fuel for 600 hours would be about £8 10s., making £24 in all. He thought a distance of 2 miles as a maximum could be pumped.

STAVELEY COAL AND IRON COMPANY, LTD.

In the Palace of Engineering, the Staveley Coal and Iron Company, who are colliery owners, ironfounders, and chemical manufacturers, make a representative display of their specialities—including cast-iron pipes, ammonia products, coal-tar products, and acids. The Staveley Company's output of coal is 4,000,000 tons per annum, of pig-iron 400,000 tons, of cast-iron pipes 1,000,000 tons, and of tarred slag 150,000 tons. They manufacture cast-iron pipes up to 72 in. diameter.

"MONITOR" PATENT SAFETY DEVICES.

Several "Monitor" patent safety devices have been fitted to power plant at the Exhibition. There are several types of these appliances. The "Monitor" patent valve, for water, oil, gases, &c., is entirely automatic; and the body can be moved round to suit horizontal, downward, or upward flow pipe lines. There is a whistle alarm, which can be set to operate on a given reduction of flow in the pipe. The "Monitor" oil-pressure alarm is useful for protecting static pressures, as in forced lubrication systems of high-speed engines, air-compressors, &c. They are made by the "Monitor" Patent Safety Devices, Laburnum Avenue, Wallsend-on-Tyne.

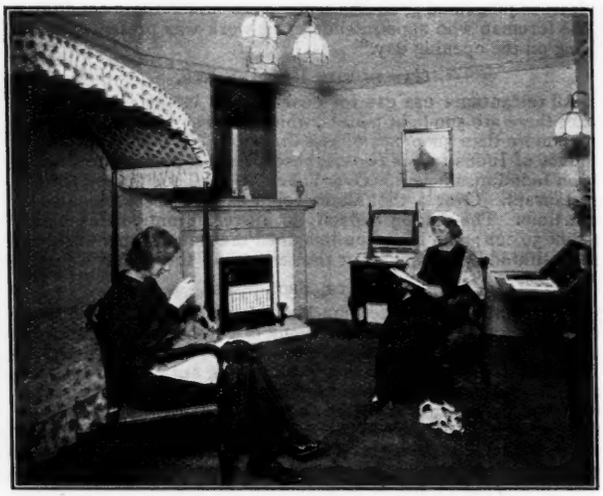
NEWALLS INSULATIONS.

Those interested in insulation economy will note the work carried out on Messrs. Babcock and Wilcox's boiler group at the Exhibition steam generating station by Newalls Insulation Company, Ltd., of No. 4, Mosley Street, Newcastle-on-Tyne. The firm specialize in, among many other things, an 85 p.ct. magnesia covering, "Newtempheit" high-temperature covering, and "Nonpareil" insulating bricks. The whole of their specialities are manufactured in their own factories, which, they say, are the most complete and extensive factories devoted to this trade in Europe.

A RUBBER GARDEN.

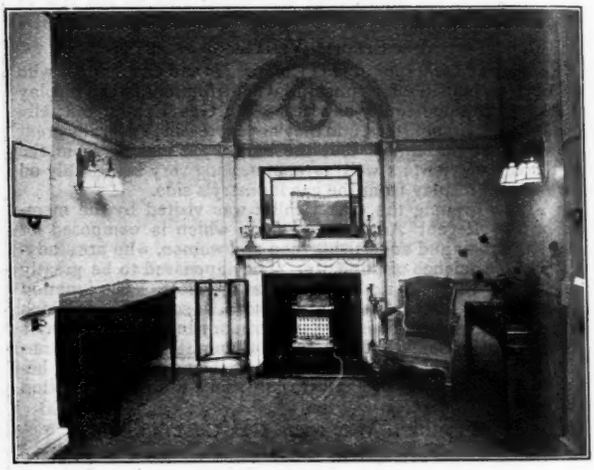
The North British Rubber Company, at their stand in the Palace of Industry, have laid out a beautiful old-world garden full of lovely flowers, and having flagged pathways running through it; and every bit of it is made of rubber—including the flowers.

MORE PHOTOGRAPHS FROM THE GAS EXHIBIT AT WEMBLEY.



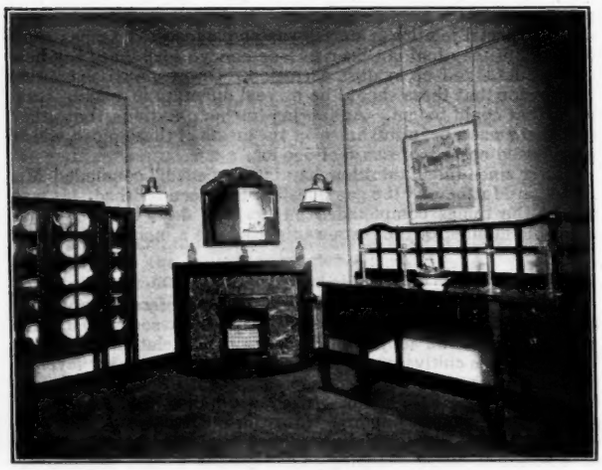
The Bedroom in the Seventh Tableau ("Old Age").

Showing gas-fire for the provision at all times of that steady temperature which is so grateful to the aged. Modern lighting by inverted incandescent burners, fitted with soft-coloured artistic shades, providing a softly diffused light, very restful and helpful to ageing eyes, for which gas is specially recommended.



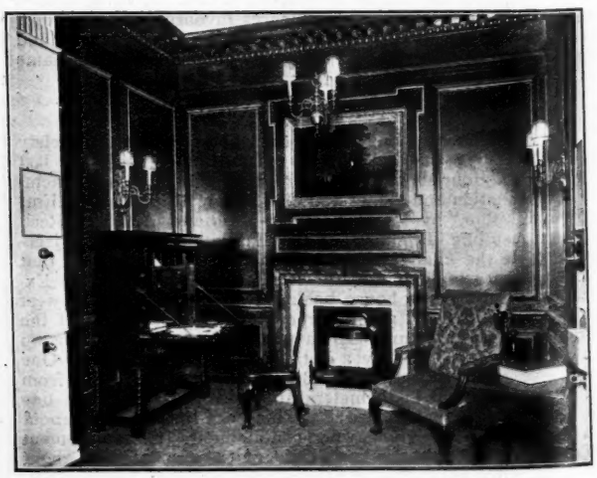
Sitting-Room of the "Old Age" Tableau.

The room is furnished in the Robert Adam style, with modern gas-fire and up-to-date lighting providing means of ever-ready warmth and light for the convenience of the occupier.



A Modern Dining-Room.

Showing up-to-date gas-fire and inverted burners.



Business Man's Room.

One of the rooms with suggestions for lighting and heating for a business man, showing how freedom from noise and interruption, with cheerful warmth, may be secured by the installation of up-to-date gas-appliances harmonizing with artistic surroundings.

CENTENARY OF GAS SUPPLY IN FRANCE
AND
JUBILEE OF THE SOCIÉTÉ TECHNIQUE DU GAZ.

IN view of the celebrations of the centenary of gas supply in France and the jubilee of the Société Technique in which the President (Mr. Samuel Tagg, M Inst.C.E.) and eighty or ninety members of the Institution of Gas Engineers will be joining at the latter part of next week, we are to-day publishing several articles dealing with the history of gas supply in France, descriptive of the excellent Gas Exhibition which has been organized in connection with the celebrations, and giving information as to certain of the works supplying gas to Paris and its environs. These articles will afford interesting reading to those visitors from the British Gas Industry who will be visiting Paris to participate in the rejoicings, to felicitate their colleagues of the French Gas Industry, and to wish them a magnificent progress in technical and commercial expansion. We have to thank all in this country and in France who have assisted in providing the material for this unique issue of the "JOURNAL."

M. FRANCIS ROULAND,
Président de la Société Technique de l'Industrie du Gaz en France.
Président du Comité du Centenaire.

CENTENAIRE DE L'INDUSTRIE DU GAZ EN FRANCE.

Comité D'Organisation.

Président.

M. F. ROULAND—Président de la Société Technique de l'Industrie du Gaz en France.

Vice-Présidents.

M. L. ROLLAND D'ESTAPE—Président du Syndicat Professionnel de l'Industrie du Gaz.
M. R. ELLISSEN—Ancien Président de la Société Technique.
M. R. MASSE—Ancien Président du Syndicat Professionnel de l'Industrie du Gaz.

Commissaire Général.

M. H. LAURAIN—Ancien Président de la Société Technique.

Commissaire Général Adjoint.

M. CH. D'AUBENTON—Membre du Comité de la Société Technique, Président de la Commission de Distribution.

Membres.

MM. A. COZE, H. MARQUISAN — Anciens Présidents de la Société Technique et du Syndicat Professionel de l'Industrie du Gaz.

MM. A. BOUTAN, J. DELEURY, A. GODINET, ED. KAEUFFER, A. LEBON, TH. VAUTIER — Anciens Présidents de la Société Technique.

MM. A. BARIL, G. FRÈRE, O. GUILLET, P. DE LACHOMETTE, R. LESAGE, J. SIEGLER, G. VAUTIER, L. WATEL-DEHAYNIN — Membres des Bureaux de la Société Technique ou du Syndicat Professionnel.

Secrétaire Général : M. P. MOUGIN.
Secrétaire Archiviste : M. H. BOURON.

MESSAGES TO FRANCE.

From the PRESIDENT of the NATIONAL GAS COUNCIL (Mr. D. Milne Watson, D.L., M.A., LL.B.).

As President of the National Gas Council of Great Britain and Ireland, I beg to tender, on behalf of those connected with the gas industry on this side of the Channel, our heartiest congratulations to all members of the gas industry in France, while they are celebrating the Centenary of the introduction there of gas lighting. It is a happy augury for the future that the completion of one hundred years of gas lighting in France also marks the Jubilee of the Société Technique du Gaz.

I have extremely pleasant recollections of the visit which members of that Society paid to London two years ago; and I trust that the cordial good feeling which was promoted by their visit will be increased by the return visit this year, and will be reflected, not merely throughout the gas industries of the two countries, but at every point at which our nations come into contact with one another.

Le Président du National Gas Council (M. D. MILNE WATSON, D.L., M.A., LL.B.).

Comme Président du "National Gas Council" de la Grande Brétagne et de l'Irlande, je me permets d'exprimer au nom de ceux associés à l'industrie gazière de ce côté-ci de la Manche nos félicitations les plus chaleureuses aux membres de l'industrie du gaz en France pendant qu'ils célèbrent le Centenaire de l'inauguration de l'éclairage au gaz en France. C'est une heureuse augure pour l'avenir que le Centenaire de l'éclairage au gaz en France coincide avec le Cinquantenaire de la Société Technique du Gaz.

Je retiens les plus agréables souvenirs de la visite que des membres de la Société Technique nous ont faite à Londres il y a deux ans et j'aime à croire que les sentiments de cordialité développés par cette visite seront reinforcés par la visite de retour cette année et auront leur reflet non seulement dans les industries gazières des deux pays, mais également à chaque point de contact entre nos nations.

From Sir ROBERT GARDINER to his Colleagues and Friends in the French Gas Industry.

By the courtesy of the Editor of the "GAS JOURNAL," I am afforded, on the occasion of the approaching French Gas Centenary, this opportunity of sending a friendly message of congratulations and kind remembrances to my colleagues and friends in the gas industry of France, and especially to my fellow-members of the Société Technique, to which I have belonged since the year 1880. To my great regret I am prevented through ill-health from attending the approaching celebration. But, although absent in body, I shall be present in mind with all my French friends, especially at the banquet on the 27th of June; and I earnestly hope that the approaching Congress, under the ægis of their distinguished President, Monsieur Rouland, may be favoured by fine weather, and hold a conspicuous place in the successful and illustrious annals of the Society's meetings.

Sir ROBERT GARDINER à Ses Collègues et Amis de l'Industrie du Gaz en France.

L'état de ma santé ne me permettant pas, à mon vif regret, d'assister aux fêtes du Centenaire de l'Industrie du Gaz en France, je viens sur la gracieuse proposition du rédacteur du "GAS JOURNAL" adresser à mes collègues et amis dans l'industrie du Gaz en France, et surtout à mes collègues de la Société Technique, dont je fais partie depuis l'année 1880, mes vives félicitations et mes souvenirs affectueux. Quoique absent de corps, ma pensée les accompagnera, surtout lors du Banquet du 27 juin, et je souhaite ardemment que sous la direction de leur distingué Président, Monsieur Rouland, le prochain congrès soit favorisé par un beau temps et occupe une place inoubliable dans l'illustre et digne historique de la Société.

From Mr. HENRY E. JONES, M.Inst.C.E., President of the European Gas Company, Ltd., Past-President of the Institution of Civil Engineers and of the National Gas Council.

As an Englishman responsible for the presidency of a Company serving the populations of eight important centres in the beautiful domain of France, as an inborn admirer and respecter of French liberties, customs, and habits, and a lover of her fair and fruitful countryside, I felicitate France on her emancipation from alien oppression, on her reviving industries, and especially on her just and wise dealings with those, like my own Company, who have commercial relations with her.

I congratulate the Société Technique on its Festival in honour of the Centenary of the French gas industry, many years of the experiences of which my Company has shared.

Personally, I feel only too proud of my membership of the Société Technique de l'Industrie du Gaz en France.

HENRY E. JONES, M.Inst.C.E., Président de la Compagnie Européenne du Gaz, Ancien Président de la Société des Ingénieurs Civils d'Angleterre, et du Syndicat National du Gaz.

Un anglais chargé de la Présidence d'une Compagnie fournissant le gaz aux habitants de huit centres importants du beau pays de France, un admirateur inné et respectueux de la liberté, des moeurs et des habitudes françaises, et un amateur de son bel et fertile paysage, je me permets de féliciter la France de sa libération de l'oppression étrangère, du rétablissement de ses industries et tout particulièrement de sa manière d'agir à la fois équitable et sage avec ceux qui, comme ma Compagnie, ont des relations commerciales avec elle. Je félicite également la Société Technique à l'occasion de la célébration du centenaire de l'Industrie du Gaz, qui couronne la terminaison d'une série d'années, dans les événements desquelles ma Compagnie a pris sa part.

Personnellement je suis très fier d'être membre de la Société Technique de l'Industrie du Gaz en France.

Sir CHARLES J. JESSEL, Bart., to the PRESIDENT of the SOCIÉTÉ TECHNIQUE DE L'INDUSTRIE DU GAZ EN FRANCE.

As Chairman of the Imperial Continental Gas Association, which has been in the past century the undertaker of gas concessions in Bordeaux, Marseilles, Toulouse, and Lille, I desire to give expression to my sincerest congratulations to the Société Technique de l'Industrie du Gaz en France on the occasion of the centenary of gas supply in France.

Sir CHARLES J. JESSEL, Bart., à M. le PRÉSIDENT de la SOCIÉTÉ TECHNIQUE DE L'INDUSTRIE DU GAZ EN FRANCE.

Comme Président de la Imperial Continental Gas Association qui durant le dernier siècle était concessionnaire pour l'éclairage au gaz des villes de Bordeaux, de Marseille, de Toulouse et de Lille, je désire adresser à la Société Technique de l'Industrie du Gaz l'expression de mes félicitations les plus sincères à l'occasion du Centenaire de l'industrie gazière en France.

COMMEMORATION OF THE FIRST FRENCH GAS-WORKS.

Philippe Lebon.

THE first event in the long and interesting programme arranged by our colleagues across the Channel to celebrate a century's gas service in France and the Jubilee of their Société Technique, took place on the morning of May 24.

In the presence of a large company representative of the Paris Municipality and industrial and scientific circles, there was unveiled in an old building of the St. Louis Hospital a tablet, the inscription on which records that it marks the site of "the first French gas-works (1818-62) constructed according to the invention of Philippe Lebon, under the auspices of M. le Comte de Chabrol (Prefect of the Seine Department, &c.)."

M. GEORGES LALOU, who officially represented Paris at the ceremony, paid homage to the memory of Philippe Lebon and the Count of Chabrol, recalling the struggle of the early pioneers of the gas industry, not only against the oil and candle industries, but even against savants like Gay-Lussac and Dumas.

M. FRANCIS ROULAND, President of the Société Technique de l'Industrie du Gaz en France, having thanked the Ville de Paris for their patronage, lightly sketched the history of the French gas industry from the discovery of Lebon until the present day. He stressed the fact that without the tenacity of the Préfet de Chabrol and the good offices of the town of Paris, gas would long have remained unknown to them. He proceeded to enlarge upon the part played by gas to-day in the heating and lighting part of modern life; to-day it is indispensable for every Parisian. Paris at the present time has gas storage capacity amounting to 1½ million cub.m. [over 52,950,000 c.ft.], and 1444 miles of mains and services supplying 836,000 consumers.

THE ORIGINATORS OF GAS LIGHTING.

We emphasize the plural; for it would be to an extent discourteous, even if it were necessary in our judgment, to revive the time-honoured controversy as to the "discoverer" of gas-lighting. The necessity certainly does not exist, for a century and a quarter ago London and Paris were far more than seven hours apart, Ayrshire was a far cry from London, and the affairs of the *Ponts et Chaussées* Department of the French Administration were not published in the next morning's London "Times." Therefore we accept with avidity a statement we have on the best authority—that Murdoch and Lebon conceived and developed the use of gas for lighting independently and at almost the same time. *A l'Angleterre, Murdoch; à la France, Lebon.* It is very much *comme il faut*; and as our colleagues acknowledge Murdoch when they visit us, so in Paris shall we pay homage to Philippe Lebon.

Philippe Lebon, an Engineer of the French Government (Department of Bridges and Roads) commenced experimental work with gas in 1791, and completed his investigations in 1799. He noticed one day that a handful of sawdust placed in a glass bottle and heated over a fire gave off a thick smoke which burnt with a brilliant flame; and the idea occurring to him to use this medium for lighting purposes, he proceeded to evolve an apparatus for the distillation of wood, with a water condenser, and a tube for a burner. In September, 1799, he obtained a patent for what he called a "thermolampe," being careful to explain in the specification that coal could be used instead of wood. In 1801, he lighted his own house in the Rue St. Dominique with gas, arranging something of the nature of a public display. Lebon, however, was not to witness the consummation of his work. Neglect and penury had been his lot; in fact, his genius met with more derision than respect. On the night of Dec. 2, 1804, the day of Napoleon's Coronation, he was stabbed to death in the Avenue des Champs Elysées, then a dark and deserted lane, dangerous to traverse at night.

Mme. Lebon carried on her husband's experiments until the patent expired in 1814. By then, Winsor, whose reception in England had not been of the most cordial, had come to Paris and taken out a new patent; and the lighting by gas of the Passage des Panoramas was begun in January, 1817. The first gas-works in Paris, based on the work of Lebon, were started in 1818.

The following facts were quoted from an article which appeared from the pen of their Paris correspondent in "The Times" for May 24 last: Companies were formed to exploit this wonderful invention. The Opéra was lighted with gas for the first time on Feb. 6, 1822, which, by a curious coincidence, was the first night of "*La Lampe Merveilleuse*." There were not lacking prophets of evil. The light, it was declared by some, was too bright, the heat of it was oppressive. The eyes of the spectators would be injured, and the lungs of the singers would be affected. Trees would die, the decorations of the cafés would be blackened, people would be asphyxiated, and houses would run the risk of fire. The inhabitants of the Faubourg Poissonnière protested against the erection of gas-works in their neighbourhood. To allay all these fears, the Academy of Science issued a declaration that gas lighting was neither dangerous nor injurious to health, and that gas-works could be erected without any ill effects in the vicinity of dwelling-houses. On Aug. 20, 1824, a Royal decree was issued laying down for the first time the conditions on which the gas industry could be carried on in France. Of the 12,672 lanterns with which Paris was lighted a hundred years ago, only 69 were gas jets. It was not until the night of Dec. 31, 1828, that the Rue de la Paix was entirely lighted by gas.

William Murdoch first experimented on the practical use of gas when he was a boy in Ayrshire, about 1770, and the following well-known facts were recapitulated in a letter to "The Times" by Mr. David Brownlie, subsequent to the appearance of their article: He continued his experiments when resident in Cornwall as engineering representative for Messrs. Boulton and Watt; and in 1792 he lighted his own house with gas at Redruth, the first time in the history of the world that coal gas was put to a practical purpose. Murdoch equipped the first factory with gas lighting in 1802—the Soho Foundry, Birmingham, of Messrs. Boulton and Watt—being part of an illumination scheme to celebrate the Peace of Amiens. He supplied also in 1805 the gas-lighting plant for the second factory in the world to be lighted by gas, Messrs. Philips and Lees' cotton mill in Manchester. Murdoch's work on the gas process was literally amazing, as it was on the steam locomotive; and not for the first time we are made painfully aware of the utter lack of imagination of the great James Watt, who discouraged Murdoch in both these directions in which he was the pioneer. The first public gas-works in London was started in 1812; and the Company were lucky enough to have, as Chief Engineer, the services of Samuel Clegg, who had been a mechanic under Murdoch, and who, along with the latter and Lebon, can be regarded as a pioneer of the process.

The names of Minckelers, a Belgian, and Winsor, which are associated with the earliest history of gas, cannot rank with Murdoch and Lebon. Murdoch's work, about 1794, was in the direction of gas for balloons. Winsor, Winzer, or Wintzler, was a German born in Moravia, and was a mountebank. In his comment upon "The Times" article, Mr. David Brownlie states that among his exploits Winsor floated a gas company in London, and promised a dividend of £64 10s. per annum on every £6 of capital, and that later he apparently guaranteed £570 per annum for every £5. Winsor and his Company were fought by Messrs. Boulton and Watt in the House of Commons, and the first Bill to authorize a public gas company was in consequence thrown out. It eventually, however, became law on June 9, 1810.

The above-mentioned article in "The Times" drew to the columns of our morning contemporary a letter from Mr. Waynman Dixon, of Great Ayton, setting forth the same facts as that gentleman submitted to the "Yorkshire Post" last year, as recorded on p. 204 of the "JOURNAL" for Oct. 17 last. Mr. Dixon claims that credit for the invention of gas belongs to George Dixon, of Cockfield (born 1731, died 1785). The facts he chronicles are very interesting; but we agree with that eminent authority on the subject, Mr. Charles Hunt (who was good enough to contribute a commentary in our columns in the same issue), that the inventor of gas lighting was not the man who lighted up a stream of gas for the amusement of his friends—having no further use for it—but the man who was first to demonstrate its utility, and how it could be applied to the use and convenience of man.

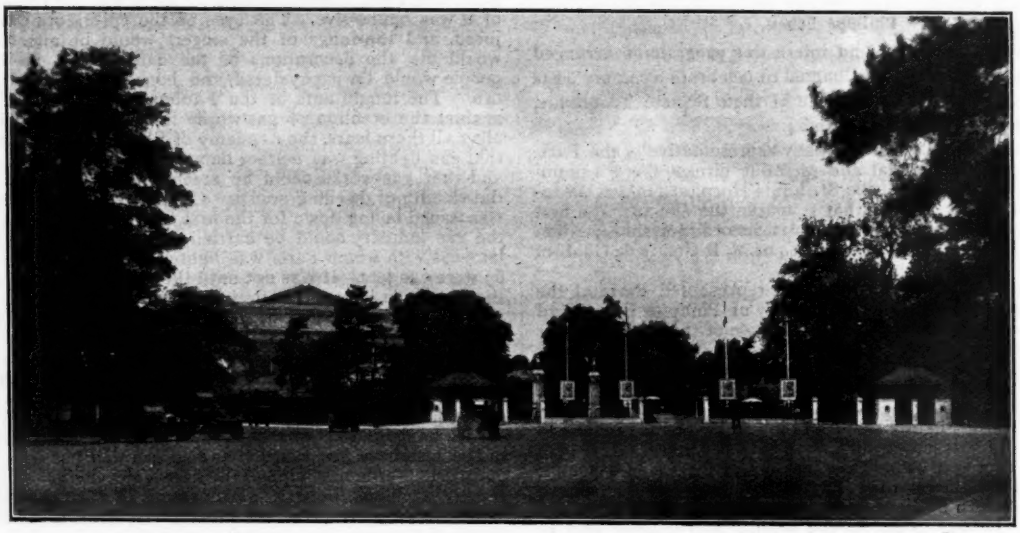
National Gas Council.—The report and accounts for the year ended March 31 last will be submitted by Mr. D. Milne Watson (the President) at the sixth annual general meeting of the National Gas Council of Great Britain and Ireland, to be held in the Hotel Great Central, Marylebone Road, N.W., on Tuesday, July 8, at 3.45. Office-bearers will be elected for the ensuing year, and there will be reported the list of members of the Central Executive Board appointed and nominated respectively by the District Executive Boards and associated bodies.

THE INTERNATIONAL GAS EXHIBITION IN PARIS.

A REPRESENTATIVE DISPLAY.

[Contributed, by request, by M. G. RECLUS, of Paris.]

THE International Gas Exhibition, organized in Paris to commemorate the Centenary of the incorporation of the first gas companies in France and the Jubilee of the Société Technique de l'Industrie du Gaz in France, was opened on Saturday, May 31, by M. de Selves, Minister of the Interior. Met by M. Francis Rouland, President of the Centenary Committee, and by M. Henri Laurain, the Chairman of the Executive, the Minister made a detailed inspection of the various halls devoted to the exhibits, in attendance upon him being notabilities of the Government and the Municipality, as well as eminent members of the French gas industry. His visit terminated at the frying demonstration and buffet of the Société du Gaz de Paris, where a young girl attired in the picturesque costume of the Boulogne fisherwomen offered M. de Selves refreshments and a glass of champagne.



ENTRANCE TO THE JARDIN D'ACCLIMATATION. [*Photographs by Méjat, Rue de Rivoli.*

AU JARDIN D'ACCLIMATATION.

The Gas Exhibition, as has been previously mentioned in our columns, is at the Jardin d'Acclimatation in the Bois de Boulogne, a few minutes' walk from the Maillot and Dauphine Gates, where several tramway and omnibus routes converge, and there is an underground station. Before the war it served both for the Paris Zoo and for the Botanical Gardens; but to-day the majority of the animals are no longer there. However, venerable trees of every description remain, as well as lawns and beautiful flower beds which at this time of the year are at their best and make a splendid background for the Exhibition. To accommodate the various sections of the display, the buildings which are situated at the entrance to the Gardens have been prepared. Besides a large hall of over 10,700 sq. ft. floor area (which is still known to Parisians as the "Palmarium," from the fine collection of palms which it once contained) the Exhibition fills about a dozen rooms on the entresol and first floor. There is also a lecture theatre where the meetings of the International Gas Congress will be held next week, and a café-restaurant which is certain to be appreciated by those in attendance. The greatest care has been bestowed upon the decoration of these buildings, for it was considered by the organizers essential to associate gas with comfort and elegance in the minds of the public. In the Great Hall a huge black and yellow awning has been erected so as to soften the glare from the glass roof; and all the stands are treated in a uniform but very artistic scheme of blue and gold. Fans have been installed to maintain an agreeable temperature and to evacuate the fumes of the many gas appliances at work.

To cover the costs of the Exhibition, the Centenary Committee appealed for subscriptions to all the gas companies and the principal allied industries; and the response amounted to over a million francs. Entry to the gardens costs one franc, as usual, but the Exhibition is free.

THE OBJECTS.

The following are the essential points which the organizers of this International Gas Exhibition have sought to achieve:

(1) To make known to the public the real importance of the gas industry; and to prove in as striking a manner as possible that the industry has not ceased to prosper, and that the future holds vast possibilities for it.
(2) To arrange a display by the manufacturers of the most recent gas-consuming appliances, not only for domestic, but for industrial purposes.
(3) To exemplify the spirit of progress which the gas industry has evidenced during the first century of its existence, by tracing the development in gas production and utilization from the beginning.
(4) To take the opportunity for intensive gas propaganda in every form.

It is proposed to examine successively how these various objects have been realized.

1.—A great number of the French public are under the impression that the gas industry has ceased to flourish, and that it is at any rate stationary, if not on the decline. It is with the object of altering this misconception that the large gas companies have applied their energies.

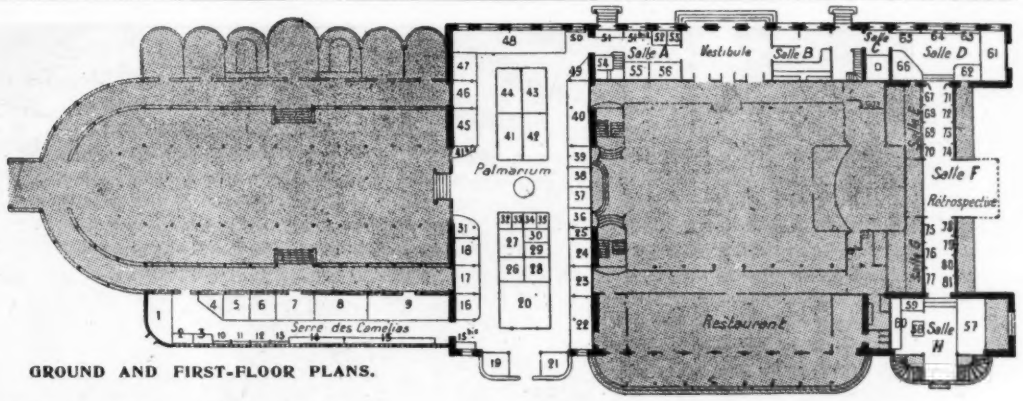
SOCIÉTÉ DU GAZ DE PARIS.

The stand of this great Company is particularly ingenious. By means of drawings and little figures they have represented, in a manner comprehensible to all, their uninterrupted progress as regards the number of their consumers, the consumption of gas, and the length of their pipe lines. Contrasted pictures, too, permit one to gauge at a glance the increase of gas appliances in the district of recent years. So that the man-in-the-street can realize the importance of the service which the Company claim to represent, they have arranged—below the title "How 840,000 consumers are served"—a collection of photographs showing the numerous operations which are necessary in order to give the most rapid satisfaction to a consumer. The importance of gas in the public lighting of Paris is exemplified by charts, plans, and photographs; and it is interesting to note that many visitors to the stand learn for the first time that numerous important streets which they thought were lighted by electricity are in reality illuminated by high-pressure gas.

The Société prove that they are up to date by showing the machines with which they make-out accounts, print-off addresses, &c. Finally, their Physical Research Laboratory shows the apparatus they are developing for the tracing of stray electric currents, which are partly responsible for the corrosion of gas-mains.

LA SOCIÉTÉ D'ECLAIRAGE, CHAUFFAGE ET FORCE MOTRICE.

The "E.C.F.M.," who are responsible for the supply of gas in the suburbs of Paris, show in relief the layout of their principal works at Gennevilliers. This, correct to the smallest detail, conveys to the visitor how extensive and up-to-date the undertaking is. Round the stand are a number of charts relating to the output of gas, the number of consumers, &c.; and these all show rapidly rising curves.



GROUND AND FIRST-FLOOR PLANS.

COMPAGNIE CENTRALE D'ECLAIRAGE PAR LE GAZ.

This firm (Lebon & Cie.) are very well represented by panorama views of the towns of Chartres, de Grenade, d'Alger, and du Caire, examples of their European and African stations.

JOINT BYE-PRODUCT EXHIBIT.

On a single stand the Comité Central des Cokes de France, the Comptoir Francais de l'Azote, and the Comité des Producteurs et Distillateurs de Goudron bring before the public in a striking form how numerous and important are the industries which deal in the bye-products of gas manufacture. There is displayed a 1000-kg. block of coal, round which are grouped the exact quantities of the various products obtained by its distillation; and pictures demonstrate the uses of each of them.

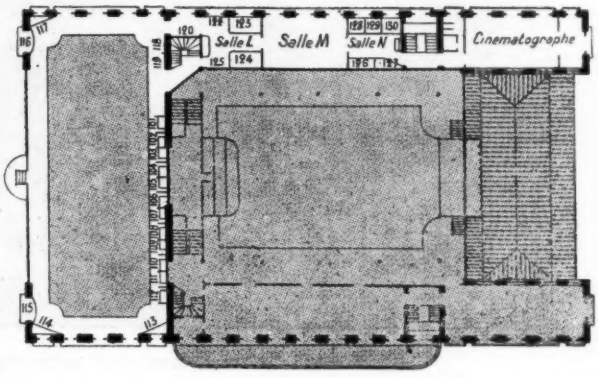
COMPAGNIE POUR LA FABRICATION DES COMPTEURS ET MATÉRIEL D'USINES À GAZ.

The stands of the manufacturers of gas-works plant above all seek to make the public realize that gas-making plant is being continually modernized and developed, and the display will prove of equal interest to professional gas men. The above-named Company show apparatus for the debenzolizing of gas by the activated carbon process. Up to the present, this new method has only been worked on a practical scale at the Grenoble Gas-Works; but the results of the experiment have been so satisfactory as to assure the extension of the process in France, where recent legislation has made benzole scrubbing obligatory.

On the same stand is shown a new type of consumer's meter—the "Sigma"—which consists of two bells rising and falling alternately in an oil bath. From this meter the same precision is obtained as from the wet meters normally employed in France; but it has the advantages of needing less attention owing to the fact that its accuracy is not dependent on the level of the liquid, and that for a similar capacity it occupies less space than the wet meter.

ATELIERS BONNET-SPAZIN.

This Lyon firm specialize in the construction of gasholders, and



they show a model of the "dry" or "tankless" type. Much interest will be taken in the latter, in view of the fact that on the visit to Douai on June 29 the *congressistes* will have the opportunity of inspecting such a holder at the Arbel Works.

PIPES.

The Société des Tuyaux Chameroy show sections of asphalted steel main up to 1 metre in diameter, and intimate the kilometre run of each size which has actually been sent out from their shops.

Similar displays have been arranged by the Fonderies de Pont-à-Mousson for cast-iron pipes, and by the Aciéries et Usines à Tubes de la Sarre for solid-drawn weldless steel pipes.

2.—GAS APPLIANCE SECTION.

Lighting.—Among the exhibitors of lighting appliances, the

THE GREAT HALL—RADIATION LIMITED IN THE FOREGROUND.

ANOTHER VIEW IN THE GREAT HALL.

Sté. Francaise d'Incandescence par le Gaz (Système Auer) show public lamps with 5, 7, and 11 nozzle superheated cluster burners. The burners are of the duplex type, which permits the automatic extinction of some of the mantles at a predetermined hour. The firm's factory lighting burners are also interesting. These are supplied with a mixture of gas and air from a compressor; the system permitting of small 50 to 200 litre points giving a high duty—0·6 litre of gas per mean horizontal candle power. Maison Raymond, Fils, have a special attraction for the public in their show of the latest types of decorative appliances including pendants and bowl fittings with switch lighting. The Société du Gaz de Paris have made a special installation of outdoor lighting appliances employing 3 and 5 mantle superheated clusters.

Domestic Heating and Cooking.—This section of the Exhibition is the most imposing, for it includes the display of some forty manufacturers. Among the most striking of the exhibits is that of Maison Arthur Martin. Their works are at Revin in the Ardennes, and were completely destroyed during the war; but a glance at their display is sufficient assurance that the damage has been entirely repaired. There are very elegant radiators of a new model, gas cooking ranges for domestic and restaurant use, &c. We may remark that these appliances follow closely the lines of the British makers, a fact which is proved by contrasting this stand with that of Radiation Limited. Lady visitors to the Exhibition are particularly impressed with this exhibit of the English firms, and stop to admire the white-enamel finish of the cookers—a feature which is not yet common in France. A little further on the eye-level cooker of the Parkinson Stove Company arrests the attention. The Etablissements Ch. Pelletier show large kitchen ranges, of which they have installed many in hotels and restaurants of the first importance. As for central heating, the Société Francaise de Chaleur et Lumière show their "Phi" boiler, of which some hundreds have been installed in Paris. [Some notes translated from a paper presented at the meeting of the Société Technique at their 1922 meeting were given in the "JOURNAL" at the time.] M. G. Cantais, a specialist in central heating, shows side by side a tiny boiler for supplying hot water to a medium-sized flat and a large low-pressure steam boiler for a big building.

To bring before the public the variety of gas appliances of which they can avail themselves for domestic use, and to bring out their true æsthetic value, on the first floor there has been arranged an all-gas flat, comprising kitchen, dining room, drawing room, boudoir, bed and bath rooms.

Industrial Apparatus.—At the stand of the Cie. du Bourdonnais de Lyon may be seen a complete series of furnaces for the heat-treatment of metals; the mixture being supplied by air injection. The Etablissements G. Méker have atmospheric burners in working, with which a temperature of 1300° C. can be obtained; and the Cie. Générale de Construction de Fours demonstrate surface combustion furnaces. Lack of accommodation has resulted in Maison Savy Jeanjean only showing photographs of their biscuit and bread baking ovens, which are for the most part worked on the continuous system and employ Keith burners.

3.—A CENTURY OF GAS.

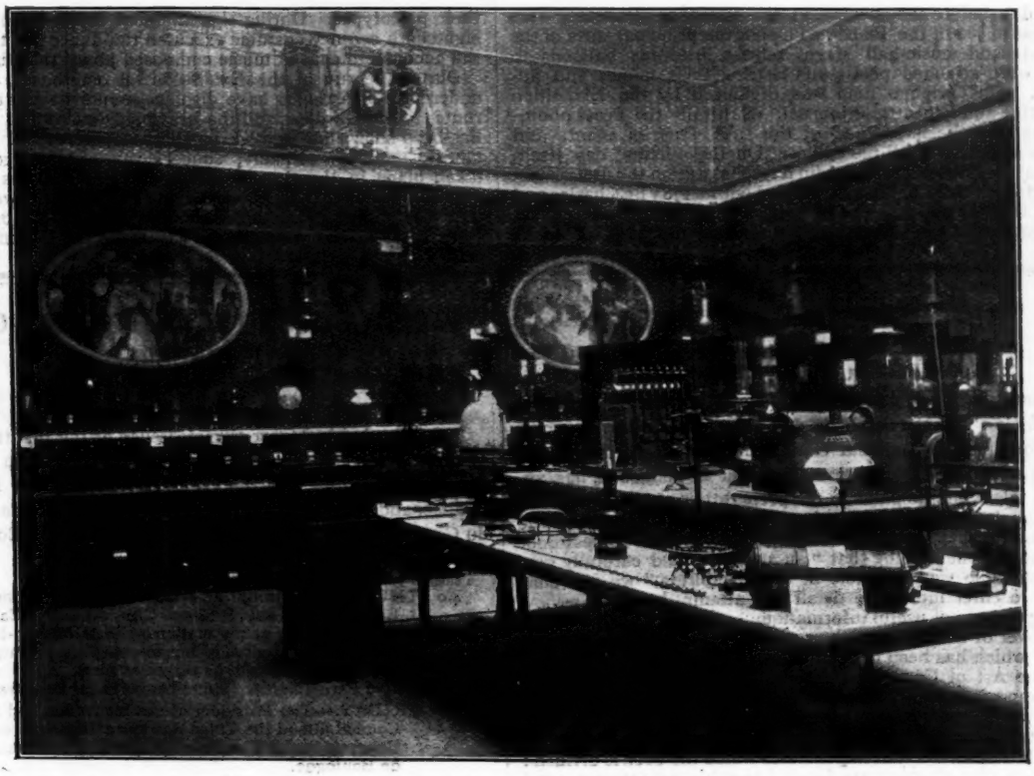
In the hall reserved for the Historical Section, the place of honour is occupied by a portrait of Philippe Lebon. This is a coloured enlargement of a miniature lent to the Centenary Committee by a little niece of the great scientist; and underneath the portrait there has been reproduced something in the nature of a prophecy which Lebon wrote in 1801, three years before he was assassinated: "Could one fail to love the service of such an obliging flame? It is going to cook your dishes, which, just as your kitchen, will no longer be exposed to the fumes of coal; it is going to warm up those same dishes at your table, dry your linen, heat your bath water and your oven, and assist in your laundry." Manuscripts from the pen of Lebon, his original patent specifications, and drawings of his "thermolamps" are shown in cases; while on the same wall, to the right of the portrait, hang various documents relating to Murdoch, graciously lent by the Birmingham Municipal Library, and to the left are souvenirs of Minckelers, sent by the Dutch Gas Association.

On shelves round three sides of the room are shown 120 indoor lighting burners ranging from the flat-flame burner to the superheated cluster, and including Argand, hot-air, and the first Auer burners. The evolution of public lighting is demonstrated by 10 lanterns—the principal types used in the streets of Paris since 1829, when the Rue de la Paix was first lighted by gas. The forerunner of the modern cooker, the apparatus invented by Robison in 1835 is the first of a collection demonstrating the evolution of domestic heating; while a series of 36 small-scale models shows the consumer how meters have developed since the introduction of Clegg's meter. Finally the Conservatoire National des Arts et Métiers have been good enough to loan a collection of models showing early horizontal retort settings, from a setting of three in 1818 to one of seven dated 1860.

4.—THE EDUCATION OF THE PUBLIC.

The Organization Committee has had in view to make the utmost use of the Exhibition in educating the general public as to the many advantages of gas, and as to the best methods of utilizing it. Prime importance has been attached to the instruction of children in these directions, and so it has been arranged for visits to take place from the majority of schools in Paris and the suburbs. Every day, large parties of boys and girls are taken round by gas engineers, who, while avoiding anything but the elementary, seek to make an impression on the young mind. Three days a week, cookery courses, accompanied by demonstrations, are conducted by *chefs* of repute, in a large hall specially set apart for the purpose; and cookery competitions are held for girls from the technical schools.

The guide and catalogue of the Exhibition, which we deal with at length elsewhere in this issue, is on sale for the modest sum of 2 frs., and last but not least, a continuous cinema show goes on every afternoon in a hall on the first floor. Not only educational films are given, but the artistes of the Théâtre Sarah-Bernhardt present a most amusing comedy which proves that the use of gas in the household is often an important factor in conjugal bliss.



THE HISTORICAL SECTION.

LIGHTING OF THE EXHIBITION.

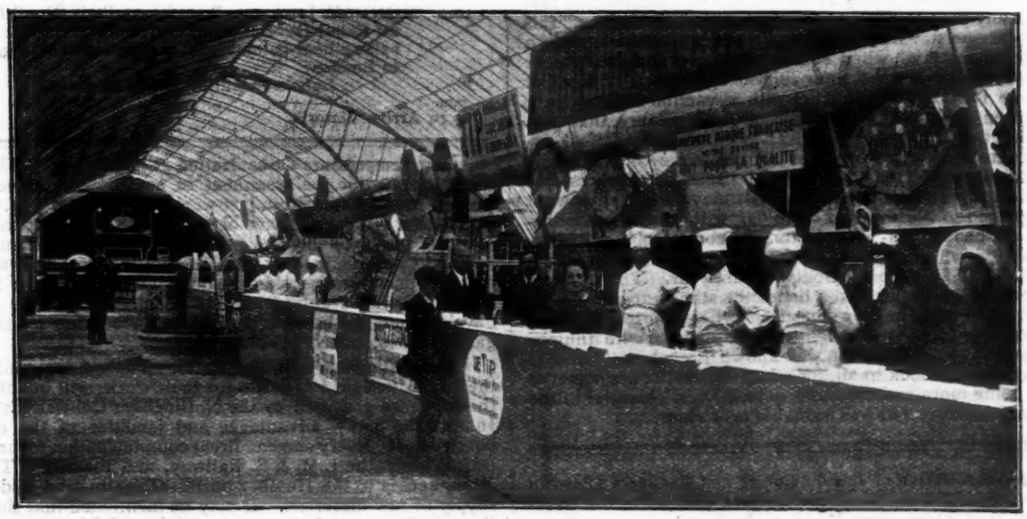
The Exhibition remains open until midnight on Thursdays, Saturdays, and Sundays; and in consequence it has been necessary to make arrangements for the lighting not only of the interior, but of the Gardens themselves. This has been carried out partly by high-pressure lamps and partly by low-pressure superheated clusters. Over the main entrance to the Gardens four high-pressure 4000-c.p. lamps have been fixed; while further back two pylons carry flashing lights of the type employed for buoys. The latter lights normally function with oil, but they have been converted for high-pressure gas. In the Gardens there are six 2000-c.p. standards of the type employed in the main streets of Paris; while the lighting of the "Palmarium" is carried out by twelve 2000-c.p. high-pressure lamps, supplemented by artistic three-mantle bracket lights with yellow glass shades. At the foot of the staircases, there are very elegant Louis XVI. chandeliers enclosing 5-candle clusters.

ALL-GAS KITCHENS.

In collaboration with the Ship-Owners Association (Fisheries Section), who are conducting a campaign in France for the popularization of the consumption of fish, the Société du Gaz de Paris have installed in a large disused conservatory a gas frying kitchen. At this buffet visitors can partake for 1 franc of a liberal helping of fried fish and potatoes; the object being to impress them with the excellence of fish as a diet and with the advantages attending its preparation by gas. Nearby a continuous gas baking oven turns out *brioches* and rolls. The greatest care has been bestowed on the ventilation of this apartment, so as to preserve a comfortable temperature and ensure the absence of any fumes.

PUBLICITY.

It will be of interest to say something of the publicity work in connection with the Exhibition—first in bringing it to the attention of the public, then arousing curiosity, and finally drawing people to the Jardin d'Acclimatation. The Organization Committee began a month before the Exhibition by sending to all the gas companies special adhesive labels for their correspondence, gas accounts, &c. These were reproductions of a poster which first made its appearance on hoardings in Paris and the suburbs about the middle of May. A week before the opening, the Committee arranged for the official unveiling of a tablet at the Hôpital Saint-Louis, commemorating the site of the first gas-works in Paris. As recorded elsewhere, speeches were made by public men on this occasion, and in particular by the President of the Municipal Council of Paris. The following day all the papers appeared with reports of the proceedings and articles on Philippe Lebon and the Centenary Exhibition.



THE FISH-FRYING DEMONSTRATION AND BUFFET.

The day before the opening, in the afternoon, Parisians were surprised to see in the Place de l'Opéra the principal stars of the legitimate and music-hall stages release little gas balloons to which were attached post-cards bearing their names and addresses. This original item was organized by the Exhibition Committee and a theatrical Journal. Naturally the Press photographers had been warned of this *très Parisien* event, and pictures appeared in all the dailies. On the opening day itself, there was re-enacted at the Jardin d'Acclimatation the first ascent in a hydrogen-filled balloon, as carried out in 1783 by Charles and Robert, the physicists. The balloon and the basket were exact reproductions of the original, and the aeronauts were attired as their prototypes. During the filling of the balloon, artistes in eighteenth century costume executed the dances of the period to the accompaniment of music composed about that time.

During the run of the Exhibition all omnibuses, trams, and underground carriages have displayed small posters showing the routes to the Gardens, and the previously mentioned cinema film has been shown for a week in all the theatres run by the Gaumont Company. Finally, concerts by a military band have taken place in the Gardens, and two or three times a week the programmes have been published in the Press. It would appear that this publicity has indeed gained its ends, for on two days, June 8 and 9, over 50,000 people visited the Exhibition.

THE EXHIBITION CATALOGUE.

A Text-Book on Gas for the Consumer.

Congratulations are due to our contemporary, the "Journal des Usines à Gaz," for the catalogue and guide which they have produced for the International Gas Exhibition in Paris. M. H. Laurain, under whose direction the paper is published, has apparently taken infinite pains in the preparation of the book; and he not only knows the industry from A to *Z*, but understands the actual and prospective gas-consuming public. So it comes about that instead of mentioning that "an attractive and carefully prepared catalogue was available at the Exhibition," we feel constrained to enter into more detail and attempt briefly to review this compendium of useful information.

The cover of the catalogue bears the symbolical figure of light and heat which has been used to advertise the Exhibition, and a title "The Art of Consuming Gas"; and thus it is suggested straightway to the visitor at the Gardin d'Acclimitation that if he pays for gas it is up to him to know something of the best way to burn it. The actual catalogue of the Exhibition is confined to the last of the ten chapters into which the book is divided; and the first nine chapters are devoted to subject-matter intended to educate the consumer in elementary gas matters and to bring him satisfaction in its use.

Chapter 1 gives an interesting account of the discovery and early history of gas, and also lightly describes the various operations of gas-making: the author hoping that "these few pages may remind you from time to time, as you turn the gas tap, at the price of what efforts in the past and what complexities in the present you are given the little flame which brings you light, heat, and comfort. Chapter 2 gives valuable advice to the ordinary consumer as to buying gas appliances, and explains how they should be regulated and maintained; and it concludes by assuring the consumer that every little care given to the upkeep and supervision of his appliances will be reflected in his gas bill.

Chapter 3, extending to over 40 pages, is devoted to a brilliant effort to arrest and retain the interest of *madame*. It consists of a week's menu for each of the four seasons of the year, and includes the recipes and cooking instructions for all the principal dishes mentioned. There follows a chapter on coke, in which is emphasized the necessity of carefully selecting the right size of fuel for the particular appliance. There is, of course, a wider domestic field for coke in France than in this country—it must be remembered that until comparatively recently water gas was not allowed to be distributed, and it is probable that this has to a large extent resulted in the development of other means of utilization; and a variety of cooking ranges, *calorifères*, and central-heating boilers exists. Dealing next with sulphate of ammonia, the author mentions that the consumption of this commodity rose from 50,000 metric tons in 1903 to 150,000 tons in 1923; and in the following pages he briefly describes to the unsuspecting layman the many uses of tar and its derivatives. "*Madame*," this latter chapter opens, "when you admire the brilliant colours of a new length of material, when some subtle perfume greets your senses; you, *monsieur*, when your *coiffeur* operates with a violet or heliotrope friction or your chef with a vanilla cream; have you ever given a thought to the origin of those colours, that perfume, or that taste?"

The consumer is next invited to a brief survey of the many applications of gas to industry; and if he reads the four or five pages of interesting information offered, it may occur to him what a curious place the world would be to-day without the gas industry's help. A chapter on "Fish," from the commercial and dietetic points of view, reminds one of the co-operation of the industries in a *Semaine de Poisson* at Boulogne last year. Then follows the guide to the Exhibition and a list of the stands, together with the ground-plan which is reproduced elsewhere in this issue of the "JOURNAL." The book is lightened throughout with thumb-nail sketches by M. Métivet, the well-known French cartoonist.

We commend the book to all, for education of the consumer is nowadays being more and more recognized as an essential in the gas industry. Here we have a valuable precedent.

Southern Association of Gas Engineers and Managers (Eastern District).—The next meeting af the Eastern District of the Association will take place next Monday, June 23, at 2.30, at the Institution of Gas Engineers, No. 28, Grosvenor Gardens, S.W.

PARIS VISIT OF THE INSTITUTION OF GAS ENGINEERS.

June 26 to June 30.

The following is the programme issued by the Institution of Gas Engineers in connection with the visit to Paris, which is to follow the annual meeting, for the Centenary of the Gas Industry in France, and the Jubilee of the Société Technique de l'Industrie du Gaz en France (including an International Gas Congress and International Gas Exhibition).

o'clock.

4.0 THURSDAY, JUNE 26.—Train leaves London, Victoria, Southern Railway, S.E. and C.S., *viâ* Dover-Calais. Members should be at the station at least half-an-hour beforehand for registration of luggage through to Paris.
Dinner will be served *en route*.

10.55 Arrive Paris (Nord). Hotel conveyances meet train.

9.0 FRIDAY.—The President of the Institution and Members of Council attend the Third Session of the International Gas Congress in the Theatre of the Jardin d'Acclimatation, Bois de Boulogne.

9.30 Auto-cars leave Grand Hotel, opposite Opera House.

11.0 A wreath will be deposited by the President on the grave of the Unknown Warrior at the Arc de Triomphe de l'Etoile.
Visit les Invalides and Tomb of Napoleon.

12.15 Return to Hotels for luncheon at 12.30.

14.30 Auto-cars leave Grand Hotel for afternoon drive, visiting the Louvre Museum, Sainte Chapelle, the Cathedral of Notre Dame, Place des Vosges, and Cimetière du Père Lachaise.

17.0 Arrive at Grand Hotel.

20.0 Official Banquet at the Palais d'Orsay. (Orders and Decorations.)

20.30 Ladies attend performance at the Opera.

10.30 SATURDAY.—The President of the French Republic visits the International Gas Exhibition, Jardin d'Acclimatation.

12.30 Luncheon as may be arranged by members individually.

13.45 Auto-cars leave 6, Rue Condorcet for visit to the Landy Gas-Works and reception by invitation of the Société du Gaz de Paris.

17.0 Reception at the Paris Hôtel de Ville by the Conseil Municipal.

20.0 Dinner at hotels.

7.50 SUNDAY.—Special Train leaves Paris (Nord Station) for excursion to Douai and Saint Quentin, by invitation of the Société Technique de l'Industrie du Gaz en France.
Inspection of tankless gasholder at the Arbel Works at Douai.
Luncheon at the Douai Hôtel de Ville, by invitation of the Société Saint-Quentinoise d'Eclairage.
At Saint Quentin visit a restored gas-works and other features of interest.

20.30 Train arrives at Paris (Nord Station). Hotel conveyances meet train. Dinner at hotels.

10.0 MONDAY, JUNE 30.—Train leaves Paris (Nord) for London, *viâ* Calais-Dover. Members should be at the station at least half-an-hour beforehand, for registration of luggage through to London.
Luncheon will be served *en route*.

p.m.

5.10 Arrive Victoria.

Low-Temperature Carbonization at Nottingham.—The Nottingham scheme for the treatment of coal by the low-temperature process was mentioned in last week's "JOURNAL" (p. 735). We notice that suggestions have been made to the effect that the new venture will probably revolutionize the arrangements for gas supply at present in operation at Nottingham; but such assertions are pure surmise and have no foundation in fact. Sir Dennis Readett-Bayley's enterprise has been welcomed as a valuable development, but how far it will have a bearing on the present gas supply is entirely problematical.

The Nottingham Colwick Estates.—Those firms contemplating the acquisition of a new site for their works will be interested in the brochure prepared by the Nottingham Colwick Estates, Ltd. In this the many advantages and facilities of the estates are pointed out. Every site has direct communication to the L. & N.E. Railway and the L.M. & S. Railway, and the River Trent gives direct access to the Humber ports. The situation is ideal for the supply of raw materials. It may be mentioned that the National Benzole Company, Ltd., and the Midland Coal Products, Ltd., are among the firms who are enjoying the advantages of the estates.

THE GAS SUPPLY OF PARIS AND THE SUBURBS.

A Brief Historical Review.

A GLANCE at the plan of the suburban gas-supply district of Paris, which we reproduce elsewhere to accompany the notes on the Gennevilliers Works, conveys an impression of orderliness, which indeed exists. One might infer from the arrangement that the gas supply of the city, no less than that of the suburbs, had been evolved and developed along unobstructed lines. The present position justifies such a supposition; but, actually, the gas supply of the "City of Light" was a cork in a game of battledore and shuttlecock which continued for some three years, and at one time that essential public service was within a few hours of becoming "nobody's child."

THE OLD RÉGIME TO BE SUPERSEDED.

The first gas-works in Paris were built in 1818, as recorded elsewhere, and the present stage of development and knowledge in the gas industry owes much to French engineering and initiative—extracts from "King's Treatise" in an article on p. 839 of this issue testify to this. Here it is our intention briefly to summarize events connected with a burning question of twenty years ago—a controversy faithfully followed for four years in the columns of the "JOURNAL."

The old Paris Gas Company—la Compagnie Parisienne d'Eclairage et de Chauffage par le Gaz—was the result of an amalgamation, in 1855, of certain older companies. The Company was granted a concession for 50 years, expiring on Dec. 31, 1905; and throughout the half-century progress was registered, and not only were shareholders and consumers well satisfied, but also the Municipality of Paris, for the Company were bound by their concession to work in a sort of partnership with the City, who received *octroi* on the materials brought-in and a substantial proportion of the sales revenue.

We do not intend here to discuss the law or the circumstances which irrevocably doomed the old Company at the close of 1905; but the impending death of that very respectable and only middle-aged corporate body was early in 1903 already causing a stir among possible inheritors. Keen competition developed in a hopeful circle of prospective *concessionnaires;* and favourites in the race were a group of American capitalists represented by MM. Devaluez and Duchanoy. Claims and deliberations continued until the half-year, when the Municipal Council of Paris, on the recommendation of their Special Committee presided over by M. Chautard, decided to discuss a draft concession to the Americans. The Prefect of the Seine, M. de Selves, was against it; but a guarantee from the financiers to pay the City 17 million francs annually was a deciding factor. However, the meetings of the Council early in July, 1903, brought two surprises in rapid succession—first, the American scheme was rejected on the "foreign capital" score; and then a startling motion from a socialist met with success, and Paris was committed to municipal control of its gas supply. Apparently it only remained for the Senate and the Chamber to sanction the suggested course, with the accompanying heavy financial clauses.

THE BILL IN PARLIAMENT.

The Bill to sanction the raising of a loan of 120 million francs for the acquisition of the Gas Company's undertakings, and the control of gas supply by the Municipality, was not tabled in the Chamber till the following July, and was then adjourned till late October. The clauses were warmly debated, and it is surprising nowadays to find that an amendment seeking to make a co-partnership provision was heavily defeated. However, the Bill was accepted by 360 votes to 177.

So far, so good; but the advocates of municipalization were to receive a serious set-back at the hands of the Senate. In the Upper House the Bill was referred to a Committee whose report showed that they were opposed to the *régie directe*, or first-hand management by the Municipality. In their opinion the system, with certain administrations, was bound "to become an instrument of political influence and electoral corruption," and the growing spirit of officialdom was likely to kill French "civic strength and independence;" moreover, such a measure would probably result in waste through "neglectful management and irresponsibility!" Their constructive criticism was that the loan should be reduced to 100 millions for the purchase of works and plant, and that it should be settled later whether the service should be "farmed" for a period or leased to the existing Company with a proviso ensuring reduced charges to consumers and increased payments to the Municipality. The weight of opinion in the City Council and the Chamber of Deputies, and the intercession of the Minister of the Interior were of no avail; and the Senate, in February, 1905, agreed to the smaller loan and condemned direct municipal control. Thus, with only ten months of the old concession to run, a new phase of the game was entered upon.

A FRESH START.

Somewhat feverish meetings of the Paris Council's Gas Committee, and of both supporters and opponents of the Bill in the Senate, were immediately held; arguments were advanced, and petitions presented. Meanwhile the Minister of the Interior sent to the Chamber the Bill as amended by the Senate, accompanied by a request that it should not be accepted, as the Government considered the "direct control" scheme the best for the City and the consumers alike.

Thus at the end of October, 1905, we find the Bill once more in the Chamber and in the hands of a Committee, who amended it in such a way as was hoped would overcome the objection of the Senate. The deputies warmly debated the matter for a week, when the Minister of the Interior closed the discussion by pointing out that the Senate had rejected municipal control because they considered it "to be a step towards collectivism; but the examples of the principal European companies under monarchical government which had adopted public control furnished proofs to the contrary." This resulted in the passing of the preamble, and discussion of the clauses was then undertaken. This was fairly prolonged, and a new Minister of the Interior again wound up the discussion by an appeal to pass the Bill. This was done, but with a smaller majority than that which favoured the previous Bill. Once more, therefore, the measure had only to pass safely beneath the Sword of Damocles for the gas supply of Paris to be municipalized; but the thread which held the sword was severed by a Committee of the Senate who, in face of the renewed arguments of the Minister of the Interior, by five votes to two recommended rejection of the Bill. A majority of 153 Senators to 125 decided that they had faith in their Committee's recommendation. The position of Paris was surely unexampled in the history of gas supply. The Gas Company's concession was due to expire in twelve days, and no steps had been taken towards negotiation with them—in fact, the Company was already in the hands of the liquidators. What was to be done?

At this juncture, M. de Selves (Prefect of the Seine) again steps into the picture, and continues to figure largely in the subsequent negotiations. Naturally the adverse vote of the Senate caused little short of consternation in the Municipal Council; but the Prefect thought it would be possible to have the gas supply controlled temporarily by managers nominated by the City and by the Company's liquidators. He was asked to formulate some scheme, and he was able to lay one before the Council on Dec. 22, 1906. It is remarkable that at 2 o'clock on the afternoon of Dec. 31 the suggested arrangement was still awaiting the consideration of the Council at a public sitting. It was, however, adopted in time. The agreement was that during 1906 the undertaking of the Paris Gas Company was to be carried on by the Liquidators, under the control of the City. Gas was to be supplied at 15c. per cub.m. for public lighting, and 20c. for private consumption. The City was to receive 3'5c. per cub.m.—2c. representing the existing *octroi* duty on the raw material, and 1·5c. an additional allowance. The profits remaining after these deductions were to be divided equally between the City and Company; and the employees were to be placed on the same basis as those in the service of the Municipality. The arrangement was sanctioned, and the necessary loans authorized, by the Chamber of Deputies in March; and M. de Selves continued his consideration of what could be done at the close of 1906.

"INTERESTED CONTROL"—THE SOCIÉTÉ DU GAZ DE PARIS.

M. de Selves had all along favoured indirect management of the Gas Undertaking, and the inevitable Committee of the Municipal Council accepted such a basis for the scheme they were now asked to prepare; but the matter dragged on, and at the end of November, 1906, the Council had only just begun consideration of their Committee's report. The excitement which ensued was perhaps some recompense for the weary years of waiting, for on Monday, Dec. 3, when the long discussion had been wound-up and the Council proceeded to vote, it was recognized by both sides that the division was about equal. There was a general rush to the telephone to call up absent colleagues; but the count showed a majority of one in favour of interested control. A Paris newspaper pointed out at the time that a single vote was sufficient to settle the question of whether or not France should be a Republic, and therefore it was perfectly valid on the smaller question of who was to control the gas supply of its Metropolis.

In virtue of this decision, offers were invited for the contract, and a representative Committee, with the Prefect of the Seine as President, was appointed to examine the proposals. Four or five applicants out of about 20 were evidently serious in their desire to obtain the concession on the terms laid down by the Prefect. No decision, however, had been come to at the end of 1906, and the Municipal Council, notwithstanding their vote that the provisional arrangement should cease with the close of the year, had to sanction its continuation for a period terminable at a month's notice.

The new concessionary company had to provide capital to the amount of 30 million francs (5 million of which would be caution money), and it would carry fixed interest at 5 p.ct.; but in the event of the working being prosperous, the company would have a share of the profits about the 20 million francs to which the City would be entitled as owners of the works—the concessionary company simply making and distributing the gas. The employees were to be placed on the same footing as those of the Municipality, and charges were to be controlled throughout. It was also laid down that coal gas only should be supplied. These conditions, comprised in a voluminous *cahier des charges* embracing every possible detail, were laid before the tenderers, one of whom (M. Ellissen) withdrew, leaving four candidates. Finally, the Municipality placed the contract with M. Rouland; and as he was also a Director of the suburban Company [see later] it meant that the control of the gas supply in the City and the suburbs

would be co-ordinated to a large extent. Certain difficulties remained to be overcome; but this was effected to the satisfaction of all, and the Société du Gaz de Paris took possession on Sept. 1, 1907.

The attitude of the old Company during these long-drawn-out negotiations was highly commendable. With the storm raging round their heads and the consciousness that their organization was doomed, the Board carried on their work and continued to present most excellent results. At the Annual Meeting of the Company in April, 1905, the Board stated that they contemplated the approaching termination of their concession in consciousness that they had fully discharged their duty to the City. In the fifty years of the Company's régime they had paid into the Municipal coffers no less than 600 millions of francs, or about £24,000,000. The Liquidators' account of their stewardship in April, 1907, also showed extremely good results; the fact being brought to light that there was a falling-off in profit of only 5·5 p.ct. compared with 1905, in spite of the loss of the suburban supply [see below].

LA SOCIÉTÉ D'ECLAIRAGE, CHAUFFAGE, ET FORCE MOTRICE.

While affairs were moving, in 1903, to a *crescendo* in the Paris Council regarding the gas supply of the City, little attention was paid to the suburbs, who, however, were taking a quiet but intense interest in the matter. Conferences were held between the various Authorities, with the result that tenders were asked for the concession, and a Company formed who undertook to supply light, heat, and motive power to the communes as from Jan. 1, 1906. M. Chamon, who had been taking a leading part in the City gas question, was at the head of the concessionaires; and associated with him was M. Rouland. The Prefect of the Seine sanctioned the arrangement on Jan. 30, 1904. One of the conditions was a reduction of 10c. per cub.m. in the price of gas to private consumers as from the beginning of 1904. This could not be done without the consent of the Paris Gas Company, whose concession allowed them to charge 30c.; but the new Company agreed to indemnify the old one. Moreover, it was stipulated by the Prefect that the reduced revenue was not to affect the amount paid to the city as their share of the profits. As to the plant, the Suburban Company was to pay the Paris Company for all mains, services, and meters put in owing to any increased consumption during the two years before their concession expired. The shareholders in the old Company were granted the prior right to subscribe for one-third of all the shares issued before Jan. 1, 1906; and they were to be represented on the Board of the new Company by two of their own Directors.

It was decided to proceed forthwith to the construction of new gas-works; the scheme being for a central station supplying, under pressure, a main completely encircling Paris and having sub-stations for storage, enrichment of the supply, &c. The site chosen for the works was Gennevilliers, which lies at the north of the peninsula formed by the Seine below Paris [see map in another article of this issue], and is part of the tract of land irrigated by the sewage of the city. Contracts were entered into with the Compagnie pour la Fabrication des Compteurs et Matériel d'Usines à Gaz; but first the sanction of the Gennevilliers Council had to be obtained. This was given by a majority of five; the Hygienic Council having expressed the opinion that the site was, as regards isolation, specially suitable for the work to be carried on there, and that one more suitable would be difficult to find in the Department of the Seine. They pointed out that the processes connected with gas manufacture had been so greatly improved, as the result of study and experience, that "any inconvenience arising from them would not be intolerable."

Thus the Gennevilliers Works came into being, and with them a highly efficient gas service for the suburbs of Paris. Those who are interested in the technical development of the district are referred to our columns: Vol. 97, pp. 87 and 278; Vol. 101, p. 228; &c.

REFLECTIONS.

In compiling these notes, the writer forgot that the events mentioned took place twenty years ago, and that the years of war, and the struggle to recover from their effect, have intervened. It will be gathered from other articles in this issue what a tremendous and successful effort has been made by the French gas industry since the war; and what will be seen in Paris next week, both in the works and at the Exhibition, amply demonstrates that in France, as in England, "*l'avenir ouvre devant l'industrie de vastes perspectives.*" The columns of the "JOURNAL" remain open to help our friends in France as well as at home, in evidence of which (if in passing we may snatch a pat on the back) we call attention to the extraordinarily complete record in its pages, from which these notes were culled.

The names of two brilliant men stood out in these events of 1903 to 1907—de Selves and Rouland, respectively the Prefect of the Seine and a Director of both the City and the Suburban Gas Companies. M. de Selves was Minister of the Interior in the late French Government; M. Rouland is now President of the Société Technique.

THE IMPERIAL CONTINENTAL GAS ASSOCIATION IN FRANCE.

NEARLY a hundred years ago—on March 10, 1825, to be exact—the Board of the Imperial Continental Gas Association deliberated on the question of supplying gas in Paris, and negotiating with Mr. Winsor on a proposal to acquire his French gas-supply rights for a sum of £5000. Nothing, however, came of this; but in 1832 the Association acquired the rosin-gas works at Lille from a local company for the sum of Fs. 40,000, together with 2 miles of mains, on the understanding that coal gas was to be substituted for rosin gas as soon as possible, owing to the difficulty of obtaining rosin from the United States of America. At that time the population of Lille was approximately 65,000. In 1907, when the Lille gas business was handed over by the Imperial Continental Gas Association to the Compagnie Continentale du Gaz, the number of inhabitants had increased to 215,000; and the total would doubtless have been even larger had not the expansion of the town been hampered by the fortifications—Vauban's masterpiece.

LILLE DURING THE WAR.

Two gas-works were erected by the Association at Lille; and these narrowly escaped destruction at the hands of the Germans when the city was evacuated by them in October, 1918. As a matter of fact the German engineers had made all their preparations for blowing-up the retort benches, exhausters, and gasholders, and had even placed the fuses, when, at the urgent request of the Manager, M. Couvreur, the Governor of Lille consented to telephone to the German General Headquarters for instructions. After a period of acute anxiety, which M. Couvreur utilized to invoke the assistance of the Mayor, the reply came that, for political reasons—in other words, the fear of reprisals—it had been decided that the gas-works were not to be destroyed. Nevertheless, considerable damage was done to the mains when the gates of the city were blown up by the Germans on leaving. The central station of the Lille Electric Lighting Company at Sequedin was not so fortunate; practically the whole of the plant was sent to Germany, and part of the works was shattered by

L'IMPERIAL CONTINENTAL GAS ASSOCIATION EN FRANCE.

Il y a près de cent ans—pour être exact c'était le 10 mars 1825, le Conseil d'Administration de l'Imperial Continental Gas Association déliberait sur la question de fournir le gaz à Paris et de traiter avec Monsieur Winsor, pour lui reprendre, au prix de £5000, ses droits pour la fourniture du gaz en France. Ces tentatives n'eurent pas de suite, mais en 1832 l'Imperial Continental Gas Association fit l'acquisition pour la somme de Fs. 40,000 de l'usine à gaz de résine à Lille, qu'exploitait une compagnie locale, avec trois kilomètres de canalisations, à condition, toutefois, que le gaz de résine serait remplacé par le gaz de houille le plus tôt possible vu la difficulté qu'il y avait à se procurer de la résine qu'on faisait venir des Etats Unis d'Amérique.

La population de Lille à cette date était 65,000. En 1907, lorsque le Gaz de Lille fut transféré par l'Imperial Continental Gas Association à la Compagnie Continentale du Gaz, le nombre des habitants s'était porté à 215,000; et il est probable que ce chiffre aurait été encore plus important si l'extension de la ville n'avait pas été arrêtée par les fortifications—le chef d'œuvre de Vauban.

LILLE EN 1918.

Deux usines à gaz furent érigées par l'Imperial Continental Gas Association à Lille et peu s'en fallut qu'elles ne fussent détruites par les Allemands lors de l'évacuation de la ville en Octobre, 1918. En effet, le génie allemand avait fait toutes préparations pour faire sauter les fours, les extracteurs et les gazomètres, et avait même posé les cartouches, mais sur les instances du directeur du Gaz de Lille, Monsieur Couvreur, le Gouverneur allemand consentit à téléphoner au Grand Quartier Général allemand pour obtenir des instructions. Après une période d'incertitude très anxieuse, que Monsieur Couvreur sut utiliser pour obtenir l'appui du Maire, la réponse arriva que les usines devaient être épargnées par raison de politique—en autres mots, de crainte de représailles. Néanmoins, lorsque les allemands à leur départ firent sauter les portes de la ville, la canalisation du gaz fut gravement endommagée.

La Centrale à Séquedin de la Société Lilloise d'Electricité fut moins heureuse; à peu près tout le matériel et les appareils furent enlevés, et une partie de l'usine fracassée par des explosifs—seul le tableau de l'usine et les cheminées restèrent intacts.

MARSEILLE.

En 1837, l'Imperial Continental Gas Association obtint une concession pour la fourniture du gaz à Marseille, et reprit de la

explosives, only the chimneys and the switchboard being left intact.

MARSEILLES.

In 1837 the Association obtained a concession for the supply of gas at Marseilles, purchasing the works of the Midi Company, which it carried on until 1856, when the contract expired and a new concession was granted to a competing undertaking. As the latter did not acquire the Association's works, mains, and land, these were gradually sold as opportunity arose.

An interesting fact in connection with Marseilles is that, for many years after 1856, the Association still kept a portion of the gas-works in being, in the hope of regaining the concession. For this purpose, in order to maintain its rights, it made gas there under supervision on one day in every year, a *procès verbal* being then drawn up by the Juge de Paix and sent to London.

BORDEAUX AND LA BASTIDE.

In 1838 the Association acquired the gas business at Bordeaux from a local company which was supplying rosin gas made by a process invented by the Association at Ghent in 1827; and in 1852 a contract was secured for the lighting of La Bastide until 1878. In 1875, when the contract was approaching its end, the whole business, both at Bordeaux and La Bastide, was put up to tender; and the Association's tender being based on the average price of coal for the past ten years (which included the Franco-Prussian War years), the result was that the contract was lost by about half-a-centime per cubic metre.

The Association had acquired the Bordeaux Works as a going concern by buying all the share certificates; these being the only title it had to the works and other property. When the Association lost the contract, a new company appeared which wanted to buy the works and mains, and the only title-deeds the Association had were these certificates, which unfortunately could not be found. Needless to say, there was a great to-do. Every nook and cranny of the London Offices was searched, and in the end an old disused safe was discovered surmounted by an enormous marble sarcophagus lid, deposited there for safe-keeping by one of the Directors, who had brought it back from Rome, After a prolonged search, a key was found to fit this safe; but the weight of the marble slab was so great that the safe could not be opened. Eventually, after great exertions, the door was unlocked and the missing certificates were found intact, to the immense relief of all concerned.

TOULOUSE AND OTHER CONCESSIONS.

The concession to light Toulouse was secured in 1840, the Association building a new works and supplying gas there until 1867. After being ousted by the Compagnie Cibiel, the Association still kept an agent at Toulouse for a long time, in the hope that it might regain the business; but unfortunately this hope proved vain. It was not until 1903 that the last of the Association's land there was sold.

In 1878 the Association acquired through M. A. Ellissen—whose name is so renowned in gas circles in France—all the works of the Société des Usines à Gaz Réunies, namely: Les Andelys, Argenton, Armentières (of famous memory), Cernay, Cholet, Estaires, Evreux, Meaux, Morez, Nonancourt, Quiévrain, Romilly s/Seine, St. Jean d'Angély, St. Yrieix, Thizy, and Uzès. With the exception of Les Andelys, Cernay, Quiévrain and St. Yrieix, all these works are now the property of the Compagnie Continentale du Gaz. Two of them—Armentières and Estaires—suffered severely during the war. It is amusing to note that the English troops at Armentières were supplied with electric lighting from Lille by the Germans, who did not discover, for a considerable time, that a cable ran from the Lille Electricity Works to Armentières.

In addition to the above towns, the Compagnie Continentale, which is the heir of the "I.C.G.A.," lights also Nancy, St. Dié, Pont-à-Mousson, Toul, Mouy, Saintes, and Corbeil-Essonnes. The capital of the Company is Fs. 50,850,000.

Compagnie du Midi l'usine à gaz qu'elle a exploitée jusqu'en 1856; le contrat étant expiré à cette date, une nouvelle concession fut accordée à une firme rivale. Cette dernière ne reprit pas l'usine, et la canalisation, ainsi que le terrain de l'usine fut vendu au fur et à mesure lorsque l'occasion s'en présentait.

Un fait qu'il est intéressant de signaler concernant Marseille, est que pendant un bon nombre d'années suivant 1856, l'Imperial Continental Gas Association a conservé une partie de l'usine dans l'espoir de regagner la concession. A cet effet et pour maintenir ses droits, on fabriquait du gaz sous surveillance un jour par an; et un procès-verbal en était dressé par le Juge de Paix et envoyé à Londres.

BORDEAUX ET LA BASTIDE.

En 1838 l'Imperial Continental Gas Association devint acquéreur du Gaz de Bordeaux exploité par une compagnie locale qui fournissait du gaz de résine fabriqué d'après un procédé inventé par l'Imperial Continental Gas Association à Gand en 1827, et en 1852 un contrat fut obtenue pour l'éclairage de la Bastide jusqu'en 1878. En 1875, lorsque le contrat tirait à sa fin, l'exploitation tant à Bordeaux qu'à la Bastide fut mise en adjudication; et la soumission de l'Imperial Continental Gas Association étant basée sur le prix moyen du charbon pour les dix années précédents (qui comprenaient les années de la guerre Franco-Allemande), la perte du contrat en résulta pour l'affaire d'environ un demi-centime par mètre cube.

L'Imperial Continental Gas Association s'était rendue propriétaire du Gaz de Bordeaux par l'achat de toutes les actions; et celles-ci représentaient en effet son seul titre de possession de l'usine et des autres biens. Lorsque l'Imperial Continental Gas Association perdit la concession, une nouvelle Compagnie se présenta qui désira acquérir l'usine et la canalisation. Les seuls titres que l'Imperial Continental Gas Association possédait étaient les certificats de ces actions; mais, malheureusement, ceux-ci ne pouvaient être trouvés. Bien naturellement il y eut un tohu-bohu effrené. Après des recherches dans tous les coins et trous des bureaux à Londres, on finit par découvrir un vieux coffre-fort hors d'usage, surmonté par un énorme couvercle de sarcophage en marbre qu'un des Administrateurs avait ramené de Rome et avait déposé en sûreté en cet endroit. Après une recherche prolongée on trouva une clef pour ouvrir ce coffre-fort, mais le poids du marbre était tel que l'on ne réussissait pas à ouvrir la porte. Eventuellement, après de grands efforts, on y parvint, et les certificats égarés furent retrouvés intacts, au grand soulagement de tout le monde.

TOULOUSE ET AUTRES CONCESSIONS.

La concession pour l'éclairage de Toulouse fut obtenue en 1840, l'Imperial Continental Gas Association y construisant une nouvelle usine et faisant la fourniture du gaz jusqu'en 1867. Après avoir été écartée par la Compagnie Cibiel, l'Association a maintenu un représentant à Toulouse pendant de longues années, dans l'espoir de regagner l'exploitation; mais, malheureusement, ce fut en vain. Ce n'est qu'en 1903 que l'Imperial Continental Gas Association vendit sa dernière parcelle de terrain dans cette ville.

En 1878 l'Association acquit, par l'entremise de Mr. Albert Ellissen, dont la renommée est si répandue parmi les gaziers français—toutes les usines de la Société des Usines à Gaz Réunies, savoir: Les Andelys, Argenton, Armentières, Cernay, Cholet, Estaires, Evreux, Meaux, Morez, Nonancourt, Quiévrain, Romilly s/Seine, St. Jean d' Angély, St. Yrieix, Thizy, et Uzès.

A l'exception des Andelys, Cernay, Quiévrain, et St. Yrieix, toutes les susdites usines appartiennent actuellement à la Compagnie Continentale du Gaz. Deux d'entre elles, Armentières et Estaires, ont souffert cruellement pendant la guerre. Il est toutefois amusant de rappeler que les troupes anglaises à Armentières ont été fourni de courant électrique de Lille par les Allemands, qui ne découvrirent pas pendant longtemps qu'il existait un câble qui reliait la ville d'Armentières avec la Centrale Electrique à Lille.

En outre des villes citées ci-dessus la Compagnie Continentale du Gaz, héritière de l'Imperial Continental Gas Association, éclaire Nancy, St. Dié, Pont-à-Mousson, Toul, Mouy, Saintes, Corbeil-Essonnes. Le capital de la Compagnie Continentale s'élève à Fs. 50,850,000.

LEBON AND THE "SPIRIT OF COAL."

By CHARLES HUNT, M.Inst.C.E.

Paris, on the eve of celebrating her Centenary of Gas Supply and Jubilee of the Société Technique, is not likely to do other than the fullest justice to that brilliant Frenchman, Lebon, who, contemporaneously with Murdoch, discovered the "Spirit of Coal." Less fortunate, however, than Murdoch, he was unable to do anything to develop his ideas before he met his untimely death at the hands of an assassin in the Champs Elysées. This was in 1804.

Some time before this, however, Murdoch's employers, Messrs. Boulton and Watt, who had for some while been hesitating whether to assist Murdoch with his invention because of the expense and the possibility of failure, became alarmed at the reports which had reached them with regard to Lebon, who is said to have declared to his friends that he would "convey warmth and light from Paris to Brachay," where his father at that time resided, and made up their minds to back Murdoch. An exhibition of gas was accordingly made at Soho in connection with the celebrations for the Peace of Amiens in 1802. A start was no sooner made there than Murdoch gathered round him a band of workmen as practical as himself, with whom he effected improvements in the design of the plant for the production of gas, some of which remain to this day. With the aid of these men, gas production soon spread throughout England, and from England it extended almost—so to speak—to the ends of the earth. In the meantime the genius of Lebon was exploited by Winsor, a native of Moravia, or expended in the production of tar, which Lebon appeared to think in the concluding years of his life was likely to be more remunerative than the production of gas.

But if the mantle of Lebon did not descend upon one of his gifted fellow-countrymen, France has fully shared in the honour of spreading the "Spirit of Coal," with all that it implies, throughout civilization. Long may the two nations be united for such useful purposes! May all success attend the celebrations in Paris! *Vive l'Entente Cordiale!*

HISTORY OF THE EUROPEAN GAS COMPANY, LIMITED.

Origin of the Concern.

In 1833 a Company was formed under the title of the French National Gas Company, with the object of undertaking the supply of gas to Boulogne-sur-Mer and Havre. But the capital of £10,000 proved quite inadequate; and it was shortly afterwards absorbed by the European Gas Company, founded for that purpose by a group of London merchants and bankers on March 6, 1835, and formally constituted by a Deed of Settlement dated Sept. 1, 1835. The deed states:

> "That the objects and business of the said Company shall be the lighting with gas or inflammable air cities, towns, and other places in France and in other parts of Europe, and the erection and establishment of works for such purposes, and the manufacture and sale of coke, oil, coal-tar, and ammoniacal liquor, and all other articles which can or may be produced from the coal or other substances employed in the making of gas."

The original capital was £200,000, which was not all called up at once; and this has been increased by successive stages to its present figure of £1,002,180.

The first Board of Directors consisted of Messrs. Henry Kingscote (Chairman), William Dobree, Samuel Lambert, George Lowe, Sheffield Neave, William Venables, and Henry Loftus Wigram. The first Secretary was Mr. Gibbons Merle. Apparently the only one of these gentlemen who had any previous connection with the gas industry was Mr. George Lowe, the Engineer of the London Chartered Company, who, after serving for some time as a Director of the European Gas Company, and then as Managing Director, was for many years Consulting Engineer.

First Expansion.

At the date of the Deed of Settlement, gas-works had already been constructed at Boulogne and at Havre, and when the second general meeting was held on July 7, 1837, gas was being supplied in these two towns and at Amiens and Caen. The lighting of Nantes was begun on Sept. 1, 1837.

Expenditure was incurred in 1837 in connection with the construction of a gas-works at Versailles, and a stock of pipes was accumulated there; but the shareholders became anxious as to the amount of capital expended and the lack of an immediate return on their investment; and a committee of shareholders was appointed to consider the whole financial position of the Company. As a result, nothing further was done at Versailles, and the stock of pipes was disposed of, while further projects for the lighting of various other towns, including Arras, St. Quentin, and a part of Paris, were dropped.

An Abandoned Project for Dublin.

It is interesting to note that in 1835 the Company sent a representative to Dublin to consider the purchase of land and the construction of a works, and that a local manager was actually appointed. Whether it was intended to operate in competition with the already existing Hibernian Gas Company or in another district is not quite clear. However, a shareholder threatened to obtain an injunction against the Company if they proceeded with the Dublin project, on the ground that the operations of the Company were by the Deed of Settlement limited to the Continent. Counsel's opinion was taken, and it was decided to abandon the idea. A separate Company was formed to undertake the Dublin project, with the title of the Alliance Gas Company; and for some time the two concerns were run under more or less the same management, sharing offices and staff.

Middle of Last Century.

In this connection it may be mentioned that, though the original Deed of Settlement refers to France and other parts of Europe, the Company's operations have in point of fact always been confined to France. In 1839, the question of lighting part of Rouen was first considered, and the gas supply there was inaugurated on April 1, 1841. The Company's stations thus consisted of Amiens, Boulogne, Caen, Havre, Nantes, and Rouen; and these have been retained until the present day.

In 1880 a separate works was built for the supply of Sotteville and certain other smaller suburbs of Rouen, while the gas-works and concessions at Bolbec and Wimereux were acquired by purchase in 1876 and 1921 respectively.

Competition.

By about 1845 the successful results of gas lighting in Paris and elsewhere led to the creation of a number of French companies and to severe competition or to threats of competition at most of the Company's stations. This competition resulted in a severe cutting of prices, which, though it had a disastrous effect on the Company's finances at the moment, was perhaps a blessing in disguise, for it led to a great development of the consumption and to a realization of the necessity for rendering the Company's position secure by obtaining the grant of exclusive rights. The local companies which were set up were, in certain cases, absorbed by the

NOTE SUR L'HISTOIRE ET LE DEVELOPPEMENT DE LA COMPAGNIE EUROPEENNE DU GAZ.

L'an 1833, se constitua une Société (La Compagnie Nationale Française du Gaz) dans le but d'entreprendre l'éclairage au gaz de Boulogne-sur-Mer et du Havre; mais son capital de 10,000 livres sterling était insuffisant, et cette Compagnie fut englobée un peu plus tard par la Compagnie Européenne du Gaz, fondée à cet effet le 6 mars, 1835, par une groupe de commerçants et banquiers de Londres, et constituée formellement par Acte de Constitution en date du 1er. septembre 1835. Cet acte expose:

> "Que l'objet de la dite Compagnie sera l'éclairage au gaz ou à l'air inflammable des villes, cités et autres endroits, en France et dans les autres parties de l'Europe, la construction et l'établissement d'usines dans ce but, et la fabrication et vente du coke, de l'huile, du goudron, de l'eau ammoniacale et de tous autres produits qui puissent être obtenus du charbon ou autres matériaux employés dans la fabrication du gaz."

Le capital original était de 200,000 livres, qui n'était pas entièrement libéré dès le commencement; ce capital fut augmenté par étapes successives jusqu'à son chiffre actuel de £1,002,180.

Le premier Conseil d'Administration comprenait MM. Henry Kingscote, Président, William Dobree, Samuel Lambert, George Lowe, Sheffield Neave, William Venables et Henry Loftus Wigram, Administrateurs. Le premier Secrétaire était M. Gibbons Merle. Parmi ces Messieurs, le seul, à ce qu'il paraît, qui avait des relations antérieures avec l'industrie gazière, était M. George Lowe, l'Ingénieur de la Chartered Company de Londres. Après avoir passé quelques années, d'abord comme Administrateur, puis comme Administrateur-délégué dans la Compagnie Européenne il devint ensuite et pour très longtemps son Ingénieur-conseil.

A la date de l'Acte de Constitution, des usines à gaz avaient déjà été construites à Boulogne et au Havre, et lorsque la seconde Assemblée Générale de la Compagnie se réunit le 7 juillet 1837, la fourniture du gaz avait commencé dans ces deux villes ainsi qu'à Amiens et à Caen; l'éclairage de la Ville de Nantes fut inauguré le 1er. septembre 1837.

Pendant l'année 1837, on fit des dépenses préliminaires dans le but d'établir une usine à gaz à Versailles, et on se procura un stock de tuyaux; mais les actionnaires commençaient à s'inquiéter du montant de capital dépensé et de l'absence de dividendes; ils nommèrent une Commission pour examiner la situation financière de la Compagnie. Comme résultat de cet examen, le projet d'établir une usine à Versailles fut abandonné, et le stock de tuyaux fut vendu; en même temps d'autres projets pour l'éclairage de diverses autres villes, dont Arras, St. Quentin et une partie de Paris, furent également abandonnés.

Il est intéressant de noter qu'en 1835 la Compagnie envoya un représentant à Dublin pour étudier l'achat de terrains et la construction d'une usine; un Directeur local fut même nommé; il n'est pas certain que l'on eut l'intention de travailler en concurrence avec la Hibernian Gas Company, déjà existante, ou dans un nouveau périmètre. Cependant, un actionnaire menaça la Compagnie d'un procès si elle poursuivait ses projets à Dublin, alléguant que les opérations de la Compagnie étaient limitées par l'Acte de Constitution au Continent d'Europe. Après avoir consulté un jurisconsulte éminent, le projet fut abandonné; une compagnie indépendante fut fondée pour entreprendre l'affaire de Dublin, sous le titre de "l'Alliance Gas Company," et pendant quelques temps les deux compagnies furent exploitées sous la même Administration, en partageant les frais de bureau et de personnel.

A ce sujet on peut noter que, bien que l'Acte de Constitution fasse mention de la France et d'autres parties de l'Europe, les opérations de la Compagnie ont toujours été limitées à la France.

En 1839, la question de l'éclairage d'une partie de Rouen fut mise à l'étude, et la fourniture du gaz dans cette ville fut inaugurée le 1er. avril 1841.

A cette époque donc, les établissements de la Compagnie se composaient d'Amiens, Boulogne, Caen, Havre, Nantes et Rouen, établissements que la Compagnie a conservés jusqu'à ce jour.

En 1880 une usine indépendante fut construite pour la fourniture du gaz à Sotteville, et certaines autres communes suburbaines de Rouen. Les usines et concessions de Bolbec et de Wimereux furent achetées en 1876 et 1921 respectivement.

Vers 1845 les résultats séduisants de l'éclairage au gaz à Paris et ailleurs, amenèrent la constitution d'une quantité de compagnies françaises qui firent une forte concurrence, ou menace de concurrence, à la plupart des établissements de la Compagnie. Cette concurrence eut pour résultat une sérieuse réduction de prix, et, par conséquent, un effet désastreux sur les finances de la Compagnie à ce moment-là; néanmoins, c'était peut-être un avantage déguisé car la réduction des prix fut suivi d'un grand développement de la consommation; en même temps on se rendit compte de la nécessité d'affermir la situation de la compagnie par l'obtention de droits exclusifs. Les compagnies locales ainsi constituées, furent, dans certains cas, englobées par la Compagnie Européenne tandis que dans d'autres cas, les périmètres furent plus tard divisés entre les compagnies rivales, afin d'éviter la concurrence dans le même périmètre.

European Gas Company, while in other cases the areas of supply were eventually divided between the competing concerns, so as to avoid competition within the same area.

THE CONCESSION SYSTEM.

The Continental system of control over public services differs from that in force in this country in that the supplier treats direct with the municipal or communal authority concerned, and works under a concession of limited duration, the terms of which are subject to Government approval and set out the conditions as to the price, quality, &c., of the supply. The business is, in fact, carried on under a leasehold tenure, and provision has, of course, to be made for the amortization of the capital invested within the term of the concession.

INTRODUCTION OF METERS AND BUSINESS EXTENSION.

In the early period of the Company's history gas was supplied by tariff—that is to say, at a fixed rate per light for a specific period—and the quantity of gas supplied reckoned by the number of lights. A commencement was made in 1837 with the introduction of meters; but it was not until much later that these were generally adopted. The total number of lights supplied at the first date at which statistics are available—namely, 1841—was 9001, and this number had increased to 40,749 lights at the time when this system was dropped in 1857. The 1858 consumption was 4,166,700 cub.m., while for the year 1923-24 it amounted to 55,351,195 cub.m. The number of consumers was 133,867 on March 31, 1924, and the quantity of coal carbonized, which in 1859 was 19,467 tons, was 196,925 tons in the year 1923-24.

It may be noted in passing that the price of gas by meter in 1837 was in the neighbourhood of 18 frs., or about 14s. 6d. per 1000 c.ft., and it is of interest to find that as early as 1849 it was necessary, in order to induce consumers to take gas, to assist them to obtain fittings on easy terms, and that arrangements were then made to supply a good type of fitting practically at cost price.

FROM IRON TO CLAY RETORTS.

The original works were constructed with iron retorts, but in 1850 clay retorts, constructed at the Company's own works at Rouen, were tried with satisfactory results, and henceforth they were generally adopted.

COMPETITION AND GAS CONSUMPTION.

During the course of the Company's history many difficulties were experienced owing to competition of various kinds. At one time it was feared that portable gas, conveyed to customers' houses in cylinders, might prove a serious competitor, while endeavours were later made to supplant coal gas by gas manufactured from rosin. While these forms of competition had no permanent effect, the advent of electricity introduced a formidable competitor; and, as in England, gas lighting owes its salvation to the introduction of the incandescent burner. At the same time the use of gas for heating and cooking became more general, and it is a moot question whether, had it not been for the great development of the consumption owing to the use of gas for purposes other than lighting, more strenuous and more successful efforts might not have been made to save a larger proportion of the gas lighting. Whether owing to more extensive competition on the part of electricity or for some other reason, gas lighting has been replaced to a greater extent by electricity in France than in England, while on the other hand the consumption of gas for purposes other than lighting, and particularly for domestic heating, has not been developed to the same extent. In this connection, however, the national characteristics must be borne in mind, and the French habit of thrift will probably always act as a brake on the sale of gas. Statistics as to the consumption of gas per head of population and per consumer show that everywhere the French figures are appreciably lower than in England.

WARS AND EFFECTS.

During the ninety years of their existence, the Company have experienced many troublous times, but they passed unscathed through the Revolution of 1848 and the Franco-Prussian War of 1870-71. The greatest trial, however, was the war in 1914-18; but even in that turmoil only one works, at Amiens, had to be abandoned and shut down for a comparatively short period while the town was under fire, and the works were rapidly put in action again after the German lines were pushed back. Relatively speaking, the Company suffered very little material damage from enemy action. The greatest anxiety of that time was the maintenance of the supply of coal; and in order to insure this, four colliers were purchased to convey coal to the Company's Stations from Newcastle. Unfortunately, this measure did not insure the security which had been hoped, for, with the increasing stringency in the shipping position, the Company's boats were requisitioned by the British Government for even more vital services, and both during and after the war the maintenance of the supply of coal was a matter of the utmost difficulty. One of the Company's vessels was sunk by enemy action while under requisition; but she was replaced after the Armistice, and the Company now possess four colliers of a total carrying capacity of 8000 tons.

Another difficulty of the period immediately after the war was the sudden rise in the cost of raw materials and wages concur-

Le système de contrôle des services publics diffère de celui qui existe en Angleterre. Le Concessionnaire traite directement avec la Municipalité ou la Commune en question, et il obtient une concession d'une durée limitée, dont les conditions concernant le prix, la qualité, etc., sont sujettes à l'approbation du Gouvernement. En conséquence, la concession est en quelque sorte analogue à un bail, et le concessionnaire doit évidemment faire chaque année des provisions pour l'amortissement de son capital pendant la durée de la concession.

Pendant les premières années de l'exploitation, le gaz était vendu au tarif, c'est-à-dire à un prix fixe par bec pendant une période déterminée; la quantité de gaz vendue était calculée d'après le nombre de becs. Dès 1837 on commença l'installation de compteurs, mais ce n'est que plus tard qu'ils furent adoptés d'une façon générale. Le nombre total de becs à la première date pour laquelle des chiffres existent (soit en 1841) était de 9001. Ce nombre avait atteint 40,749 au moment où cette méthode de calcul fut abandonnée, en 1857. La consommation de l'année 1858 était de 4,166,700 m.c., tandis que pour l'exercice 1923-24 la quantité de gaz vendue a atteint 55,351,195 mètres cubes.

Le nombre d'abonnés au 31 mars 1924 était de 133,867 et la quantité de charbon distillée, qui en 1858 était de 19,467 tonnes, se montait pour l'exercice 1923-24 à 196,925 tonnes.

Le prix du gaz par compteur en 1837 était d'environ 18 francs par mille pieds cubes, soit 63 centimes par mètre cube. On constate avec intérêt que même en 1849 il était nécessaire, afin d'engager les abonnés à prendre le gaz, de les aider à obtenir les becs à des conditions favorables: on prit des mesures dès cette époque pour fournir de bons types de becs et d'appareils à peu près au prix de revient.

Au début les fours furent équipés avec des cornues en fer, mais en 1850 des cornues en terre réfractaire, fabriquées à l'Usine à Gaz de la Compagnie à Rouen, furent mises à l'essai et donnèrent des résultats tellement satisfaisants que ces cornues furent dorénavant adoptées.

Pendant l'existence de la Compagnie, maintes difficultés ont été rencontrées par suite de concurrence de diverses sortes; à un moment donné, on craignait que le gaz portatif, transporté chez les abonnés dans des cylindres métalliques, ne devint un concurrent sérieux, tandis que plus tard on tâcha de remplacer le gaz de houille par le gaz extrait de la résine. Ces concurrents n'eurent aucun effet permanent, mais à l'apparition de l'électricité, l'industrie du gaz se trouva en face d'un concurrent formidable, et, comme en Angleterre, l'éclairage au gaz ne dut sa conservation qu' à l'invention du bec à incandescence. A la même époque, l'emploi du gaz pour le chauffage et la cuisine commençait à se généraliser, et on se demande si, sans le grand développment de la consommation par suite de l'emploi du gaz pour les usages autres que l'éclairage, on n'aurait pas fait des efforts plus énergiques et plus efficaces pour conserver une proportion plus importante de l'éclairage au gaz. Soit par suite d'une concurrence plus intense de la part de l'électricité, soit pour toute autre raison, l'éclairage au gaz a été remplacé par l'électricité en plus grande proportion en France qu'en Angleterre, et, d'autre part, la consommation du gaz pour les usages autres que l'éclairage, et surtout pour le chauffage domestique, n'a pas subi le même développement. Sur ce point, cependant, il ne faut pas oublier le caractère national, et il est probable que les habitudes françaises d'épargne contribueront toujours à restreindre la vente du gaz; les statistiques concernant la consommation du gaz par tête de population et par consommateur démontrent clairement que partout en France les chiffres sont sensiblement inférieurs aux chiffres correspondents en Angleterre.

Pendant les 90 années de son existence, la Compagnie a traversé beaucoup de crises, mais elle subit sans grand dommage la Révolution de 1848 et la guerre de 1870 et 1871. La plus grande crise, cependant, fut causée par la guerre de 1914-1918, mais même pendant cette guerre, une seule usine, celle d'Amiens, dut être abandonnée, et resta fermée pendant une courte période, la Ville étant sous le feu de l'artillerie allemande. L'usine fut remise rapidement en action dès que les lignes allemandes furent refoulées; la Compagnie souffrit relativement peu de dommages matériels par suite de l'action ennemie.

La plus grande difficulté de cette époque fut de maintenir l'approvisionnement des usines en charbon; afin d'assurer cet approvisionnement, la compagnie acheta 4 bateaux pour transporter le charbon de Newcastle aux usines. Malheureusement, cette mesure ne réussit pas à assurer la sécurité qu'on avait espérée, car avec la difficulté croissante de l'approvisionnement des armées, les bateaux de la Compagnie furent réquisitionnés par le Gouvernement anglais pour des services encore plus essentiels. Dès lors, aussi bien pendant la guerre qu' après l'armistice, la fourniture de charbon aux usines ne se fit plus qu' avec les plus grandes difficultés. Un des bateaux de la Compagnie fut torpillé pendant la période de réquisition, mais ce bateaux fut remplacé après l'armistice, et la Compagnie possède aujourd'hui 4 bateaux d'une capacité totale de 8000 tonnes.

Une autre difficulté de la période qui suivit l'armistice fut la hausse inattendue du coût des matériaux et des salaires qui coincidait avec la baisse de la valeur du franc; cette situation se produisit si rapidement qu'il fut impossible de prendre à temps des dispositions d'accord avec les Autorités municipales, pour augmenter suffisamment le prix du gaz. Les comptes de la Compagnie se soldèrent avec une perte de plus de 300,000 livres (récupérée en partie plus tard) par la suite du jeu de ces facteurs pendant une période d'environ 3 mois. Le gaz à ce moment-là étant

rently with the fall in the value of the franc. This situation arose so rapidly that it was impossible to arrange with the Municipal Authorities in time for sufficient increases in the price of gas, and the Company found themselves involved in a loss of over £300,000 (a great part of which was afterwards recovered) by the operation of these factors over a period of about three months. Naturally, gas being at that moment cheaper than any other form of fuel, the consumption rose rapidly, and the total quantity sold—at a loss, unfortunately—was the greatest in the Company's history.

The costs of materials and wages having failed to stabilize themselves, it became necessary to provide a means of meeting these constant fluctuations, and, in common with other suppliers of gas in France, the Company arranged with the authorities concerned for the establishment of the price of gas periodically by formulæ which take into account, either directly or indirectly, the cost of coal, the price of residuals, and the cost of labour and general expenses.

THE PERSONAL SIDE.

In conclusion, a few words on the personal side may be of interest. The original Chairman, Mr. Kingscote, was succeeded by Mr. Sheffield Neave in 1842, by Mr. William White in 1868, Mr. H. M'Lauchlan Backler in 1888, Mr. J. Blackett Gill in 1892, Mr. N. E. B. Garey in 1900, Mr. R. Hesketh Jones in 1901, and Mr. H. E. Jones in 1914.

In 1850 Mr. Henry M'Lauchlan Backler was appointed Secretary, and the Company owe much to his ability and his zeal in the furtherance of their interests. In 1872, he became General Manager, and in 1876 he was elected a Director, while still remaining General Manager. In 1888 he became Chairman and General Manager, and he retained these posts until his death in 1892. In 1885 Mr. William Williams was appointed Secretary, and in 1892 he became Secretary and General Manager on Mr. Backler's death; in 1910 he was appointed Managing Director, which post he held until his death in 1918.

The works abroad were for the most part constructed and put into action by English staff and workmen sent out specially for the purpose; but the management of the business in France was very early placed in French hands, and this course has been entirely justified by the results obtained. The successive Managers of the European Company's stations have been able and devoted servants, who, by the maintenance of close and friendly relations with the Municipal and other Authorities, have notably facilitated the work of the Board in the not always easy task of carrying on business in a foreign country—a task, be it said, however, which with very rare exceptions has been lightened by the scrupulous justice and fair treatment which the Company have met with at the hands of the French authorities.

FOUNDATION OF THE COMPANY—FROM "KING'S TREATISE."

It may be noted that the following particulars with regard to the foundation of the European Gas Company appear in the 1878 edition of King's "Treatise on the Science and Practice of the Manufacture and Distribution of Coal Gas."

> In 1833, the French National Gas Company was projected for lighting Boulogne-sur-Mer, but their capital of £10,000 being found insufficient, the business was handed over, in 1835, to a new Association, the present European Gas Company, who were formed for this purpose, and also for lighting other towns in Europe, with a capital of £200,000. Mr. George Lowe and several London bankers and capitalists were the promoters of the undertaking, which has continued in English hands to this time. The lighting of Havre was undertaken in 1834; Caen and Amiens in 1835: Nantes followed, and a concession for part of Rouen was obtained in 1846. All the plant for these gas-works had to be sent from England, and very few of the articles required to carry on the business could be obtained in France, except at prices considerably in excess of those charged by English manufacturers. The late Mr. T. G. Barlow, who constructed various works for lighting Continental towns and cities, was one of the principal contractors employed, and the name of his firm may still be seen on several of the cast-iron tanks in use. Great difficulty was encountered in persuading the inhabitants to use gas in their shops and dwellings, and this could only be overcome by sacrificing a considerable amount in fittings, which in many cases had to be given away or let at a nominal rent.
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> This Company committed the capital fault of not securing their position by exclusive privileges, and later on, when they became successful, they suffered for this neglect, or want of confidence, by seeing competing French companies established at Havre and Amiens. The opposition at Havre was bought off in 1860, but Amiens was divided into districts, one of which had to be given up to the French Company. Dublin was also one of their stations, but an influential shareholder, having disputed their legal powers to light a city in Ireland, the Alliance Company were formed as an off-shoot, specially to undertake this one town. Exclusive privileges have now been obtained by the European in all the remaining towns, and the Company are one of the most flourishing and best conducted on the Continent. They passed through the Revolution of 1848, as well as the great war and political convulsions of 1870 and 1871, without appreciable damage, and appear to have escaped even the ruinous effects of the high prices of coals, which lately

meilleur marché que tout autre combustible la consommation augmentait rapidement et la quantité vendue—malheureusement à perte—fut la plus grande dans l'histoire de la Compagnie.

Le coût des matériaux et des salaires ne s'étant pas stabilisé, il devint nécessaire de trouver un moyen de parer à ces variations fréquentes, et, comme les autres concessionnaires d'affaires gazières en France, la Compagnie se mit d'accord avec les Autorités municipales pour l'établissement périodique du prix du gaz par des formules qui tenaient compte soit directement, soit indirectement, du coût du charbon, du prix des sous-produits, et du coût de la main-d'œuvre et des frais généraux.

En terminant, quelques mots au sujet du personnel de la Compagnie seront peut être intéressants. Au premier Président, Monsieur Kingscote, succédèrent en 1842 Monsieur Sheffield Neave, en 1868 Monsieur William White, en 1888 Monsieur H. M'Lauchlan Backler, en 1892 Monsieur J. Blacket Gill, en 1900 Monsieur N. E. B. Garey, en 1901 Monsieur Hesketh Jones, et en 1914 Monsieur Henry E. Jones.

En 1850, Monsieur Henry M'Lauchlan Backler fut nommé Secrétaire, et la Compagnie doit beaucoup à ses capacités et à son dévouement; en 1872, il fut nommé Directeur-général, et en 1877 il fut élu au Conseil d'Administration, tout en restant Directeur-général. En 1888 il devint Président et Directeur-général, postes qu'il conserva jusqu'à son décès en 1892. En 1885 Monsieur William Williams fut nommé Secrétaire, et en 1892 Secrétaire et Directeur-général, au décès de Monsieur Backler. En 1910 il fut nommé Administrateur-délégué, poste qu'il conserva jusqu'à son décès en 1918.

Pour la plupart, les usines furent construites et mises en activité par des agents et des spécialistes anglais, délégués à cet effet, mais dès le commencement, la direction et le contrôle des usines en France étaient confiés à un personnel français. Les résultats obtenus ont pleinement justifiés cette décision; les Directeurs successifs des usines de la Compagnie Européenne ont été des agents capables et dévoués, qui, par le maintien de relations étroites et amicables avec les Municipalités et autres Autorités, ont facilité notablement la tâche, quelquefois un peu compliquée, d'un Conseil d'Administration qui doit contrôler une entreprise dans un pays étranger. Il faut reconnaître, cependant, qu'à part de très rares exceptions, cette tâche a été allégée par la justice scrupuleuse et le traitement équitable que la Compagnie a trouvés auprès des Autorités françaises.

Il est intéressant de noter que les renseignements suivants concernant la Constitution de la Compagnie Européenne du Gaz se trouvent dans l'édition de 1878 du "Treatise on the Science and Practice of the Manufacture and Distribution of Coal Gas" par King.

> "En 1833 la Compagnie Nationale Française du Gaz fut projetée pour l'éclairage de Boulogne-sur-Mer, mais son capital de 10,000 livres sterling étant insuffisant, l'affaire fut transférée en 1835 à un nouveau groupement, représenté par la Compagnie Européenne du Gaz constituée à cet effet, et aussi pour l'éclairage d'autres Villes en Europe, avec un capital de 200,000 livres sterling. Monsieur George Lowe et plusieurs banquiers et financiers de Londres furent les fondateurs de cette Compagnie, qui est restée sous contrôle anglais jusqu'à ce jour. L'eclairage du Havre fut commencé en 1834; Caen et Amiens en 1835; Nantes suivit, et la concession pour une partie de Rouen fut obtenue en 1846.
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> Tous les matériaux pour la construction de ces usines durent être expédiés d'Angleterre, très peu des matériaux nécessaires pour l'exploitation des usines étant à trouver en France, sauf à des prix très supérieurs à ceux des fabricants anglais. Monsieur T. G. Barlow, qui construisait diverses usines pour l'éclairage de plusieurs Villes sur le Continent était un des principaux entrepreneurs et son nom se trouve sur certaines cuves en fonte encore en service. On trouvait beaucoup de difficulté à engager les habitants à employer le gaz dans leurs magasins et dans leurs maisons, et on ne surmonta cette répugnance qu'en sacrifiant une somme importante pour la fourniture gratuite des appareils, ou en les plaçant à un prix de location dérisoire.
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> Cette Compagnie commit l'erreur capitale de ne pas assurer sa situation en obtenant des droits exclusifs, et plus tard, lorsqu'elle commençait à faire des bénéfices, elle subit la conséquence de cette omission, ou de ce manque de confiance, par l'établissement au Havre et à Amiens de Compagnies concurrentes. La Compagnie concurrente au Havre fut achetée en 1860, mais la Ville d'Amiens fut divisée en deux périmètres, dont l'un fut cédé à la Compagnie Française. Dublin était également un des établissements de la Compagnie mais un actionnaire important ayant contesté son droit d'éclairer une Ville en Irlande, l'Alliance Company fut constituée comme compagnie subsidiaire pour entreprendre l'éclairage de cette Ville.
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> Aujourd'hui la Compagnie Européenne a obtenu des droits exclusifs dans toutes les Villes qu'elle éclaire, et elle est une des compagnies les plus prospères et les mieux administrées du Continent.
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> Elle traversa sans préjudice appréciable la Révolution de 1848, et la guerre et les convulsions politiques de 1870 et 1871; elle paraît même avoir échappé aux effets désastreux des prix élevés du charbon qui ont eu cours dernièrement.
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> La Compagnie est un heureux exemple d'une Compagnie anglaise travaillant dans un pays étranger. Ayant rencontré

prevailed. It is an instance of one of the most successful English undertakings carried on in a foreign country. Having experienced inconvenience from the unacknowledged position of English joint-stock companies in France, they were mainly instrumental in obtaining their recognition by treaty between the two countries, and many have been the advantages secured to both by these negotiations, which were principally conducted by Mr. Backler, the General Manager and Secretary, with M. Rouher, then Minister of Commerce under the French Empire. The coals used by the Company are chiefly English, but during the Franco-German war, and subsequently, Pas-de-Calais coals have been carbonized in the works in considerable quantities.

beaucoup de difficultés par suite du fait que les sociétés anglaises par actions n'étaient pas reconnues en France, elle s'appliqua à la tâche de faire reconnaître ces sociétés; les négociations aboutirent à un traité commercial entre les deux pays, qui s'assuraient ainsi beaucoup d'avantages réciproques. Elles furent menées principalement par Monsieur Backler, le Directeur-général et Secrétaire de la Compagnie, et Monsieur Rouher, Ministre de Commerce de l'Empire Français à cette époque.

Les charbons employés par la Compagnie sont principalement de provenance anglaise, mais pendant la guerre franco-allemande et plus tard, des quantités considérables de charbon du Pas de Calais ont été distillées."

THE GENNEVILLIERS WORKS.

Notes on the Main Station of the Société d'Eclairage, Chauffage et Force Motrice.

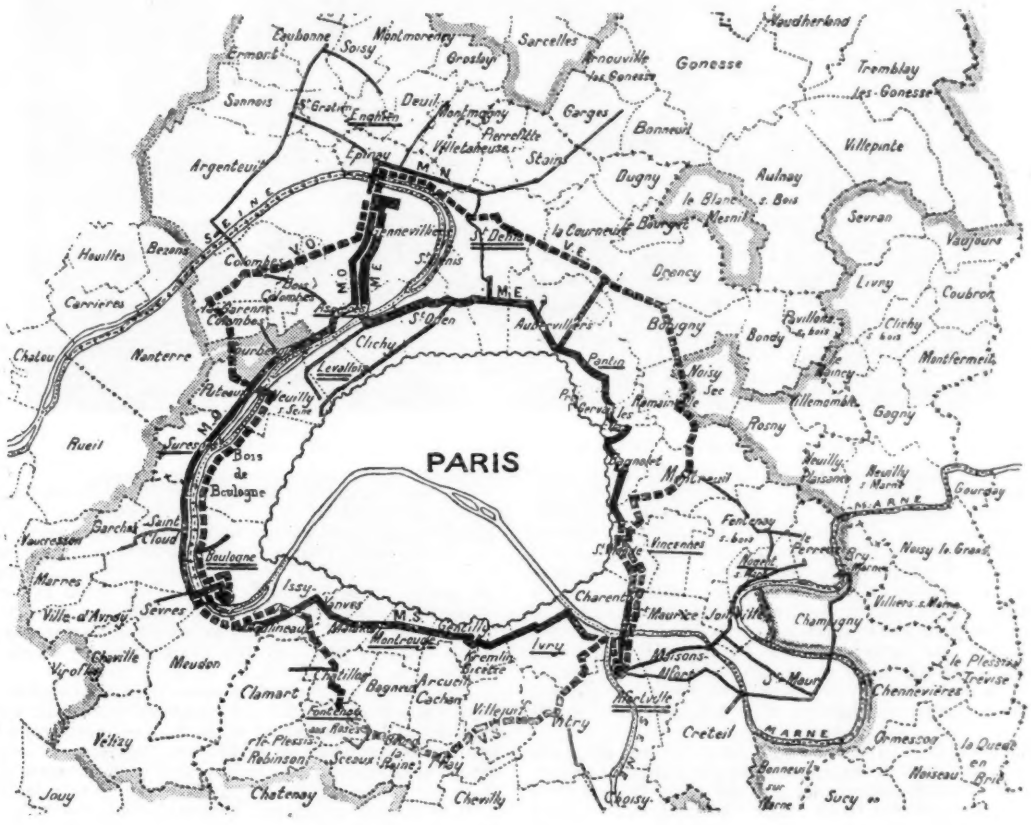
The full programme arranged for the three whole days which members of the Institution will have in Paris next week, will unfortunately prevent their visiting this magnificent works of the "E.C.F.M.," the undertaking supplying gas to the suburbs of Paris. However, the references to these works made elsewhere in this "JOURNAL," and the fact that those attending the Paris Congress on Wednesday next will make an excursion by boat to St. Germain, and proceed thence to Gennevilliers, leads us to publish the following few particulars of the plant. As in the following article on the Landy Works of the Société du Gaz, the source of our information is a brochure which, though post-war, probably does not detail the works as they now stand; but some points are of considerable interest.

The Société d'Eclairage, Chauffage et Force Motrice supply 99 Communes in the *Banlieue*—67 in the Seine Department and 32 in that of Seine-et-Oise. We reproduce a map of the area of supply, which shows the situation of the Gennevilliers Works, the two holder stations, and the girdle mains embracing the Metropolis. Begun in 1904 and commencing gas-making on Jan. 1, 1906, the main station covers an area of upwards of 175 acres near the intersection of the Seine and the Nord railway line from Paris to Ermont.

The coal storage ground is no less than 440 yards long by 110 yards wide, worked by two gantries of 131 yards span. The carbonizing plant consists of three horizontal retort houses and four batteries of chamber ovens; and something over 2000 tons of coal is dealt with per diem. The bye-products works are separate; and here they distil annually over 30,000 metric tons of tar and 400,000 cub.m. of ammoniacal liquor. The coke is screened in a large plant of 1500 tons a day capacity, being afterwards stocked in a yard of similar dimensions to the coal storage ground and likewise served by two enormous gantries.

The electrical power station contains a battery of ten boilers for steam for the general works purposes and for the generating plant, which is rated at 3000 kw. Over 25 miles of railway line exists within the works; and the sidings join up with a wharf frontage of 475 yards on the Seine, and with the sidings of the Nord main line. The rolling stock comprises 11 locomotives, 50 hopper, 18 tank, and 150 miscellaneous wagons.

Distribution is through a double system of high-pressure trunk mains and feeder mains completely encircling Paris; the "transformer" stations being at Alfortville and Boulogne-sur-Seine. At Gennevilliers there are four holders of a total capacity of over 11¼ million c.ft.; and each sub-station, which possesses the necessary governing plant between the high-pressure and secondary mains, has storage amounting to nearly 2¼ millions.


PARIS
Gennevilliers
St. Denis
Asnières
Colombes
Bois de Boulogne
Boulogne
Issy
Vanves
Clamart
Meudon
Sèvres
Suresnes
Puteaux
Nanterre
Courbevoie
Levallois
Clichy
St. Ouen
Aubervilliers
Pantin
Bobigny
Bondy
Noisy le Sec
Romainville
Rosny
Montreuil
Vincennes
Charenton
Ivry
Vitry
Choisy
Villeneuve
Arcueil
Bagneux
Montrouge
Malakoff
Châtillon
Fontenay aux Roses
Le Plessis Robinson
Sceaux
Bourg la Reine
Antony
Chatenay
Jouy
Chevilly
Thiais
Orly
Créteil
Maisons-Alfort
Charenton
St. Maurice
Joinville
Champigny
Villiers s. Marne
Noisy le Grand
Gournay
Neuilly Plaisance
Neuilly s. Marne
Le Perreux
Nogent
Fontenay s. Bois
Le Raincy
Villemomble
Gagny
Livry
Coubron
Montfermeil
Clichy s. Bois
Aulnay
Le Blanc Mesnil
Sevran
Villepinte
Tremblay les Gonesse
Gonesse
Arnouville les Gonesse
Sarcelles
Garges
Stains
Pierrefitte
Villetaneuse
Epinay
Deuil
Montmagny
Groslay
Montmorency
Soisy
Eaubonne
Ermont
Sannois
Argenteuil
Bezons
Houilles
Carrières
Colombes
Bois Colombes
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Antony
Fontenay aux Roses
Châtillon
Montrouge
Malakoff
Vanves
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Boulogne
Saint Cloud
Garches
Vaucresson
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Nanterre
Colombes
Bois Colombes
Asnières
Courbevoie
Puteaux
Suresnes
Bois de Boulogne
Meudon
Sèvres
Clamart
Bagneux
Arcueil
Cachan
Villejuif
Ivry
Vitry
Choisy

THE LANDY WORKS OF THE SOCIÉTÉ DU GAZ DE PARIS.

A POST-WAR EFFORT.

IN Paris, on Saturday afternoon of next week, the Société du Gaz de Paris will be the hosts of the *congressistes* and the many visitors from this and other countries, whom they have invited to a reception and a tour of inspection at their Landy Works. It may be mentioned that the Société du Gaz de Paris, whose capital is 100 million francs (normally four million sterling), are the gas undertakers of the French Metropolis. Through the good offices of M. Mougin, the Secretary of the Centenary Organization, we have obtained a copy of the souvenir book which was published at the time of the opening of the Landy extensions and renovations in 1922. This has enabled us to publish the following particulars of the works, which it is thought will add interest to the visit next week. Of course, further developments have taken place since the book was brought out, and we look forward specially to information regarding the Cornillon site, which on the ground plan is marked "for projected works." The latter, in fact, were put in hand in 1914, as appears from the following extract from the French, but the war intervened. The conversions throughout are approximate—merely to allow comparisons with works in this country.

BIRD'S-EYE VIEW OF THE LANDY WORKS AND PART OF LE CORNILLON.

The Société du Gaz de Paris took over, in 1907, the whole of the works, plant, and materials of the old Compagnie Parisienne d'Eclairage et de Chauffage par le Gaz. The nominal capacity of all the gas-works of the Capital was at the time only 58,400,000 c.ft. in 24 hours, or a maximum yearly output of (say) 13,767 million c.ft. In 1908, however, this figure was exceeded; and by 1909 it reached 15,144 million c.ft., and 16,979 millions in 1913. This means that from the moment of its incorporation the new Company had to make a considerable effort, and plant somewhat out-of-date and already much overloaded had to be pushed to the limit of its capacity. At the same time every thought was given to the intensive development and modernization of the works.

The remodelling of the Landy Works, begun in 1908 and completed in 1911, was the first important task undertaken. Its original output of about 6 million c.ft. in 24 hours was increased to 24½ million by the addition to its single bench of hand-worked settings of three other benches each of similar capacity, while the old bench itself was brought up to date. The works, thus equipped, took their place among the most important of the type in Europe, in fact in the whole world; and this article is devoted to a description of the plant.

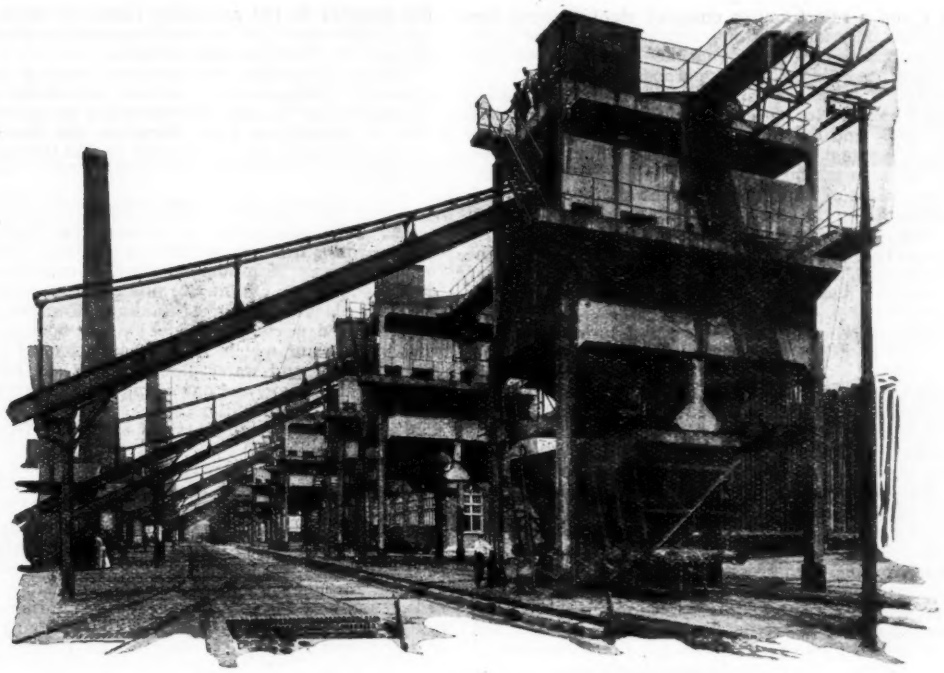
With this, however, the efforts of the Société did not end, for in 1912 the reconstruction of La Villette Works was put in hand on even more modern lines; and in 1914 were laid the foundations of a works even larger than Landy on the neighbouring Cornillon site. The war put a temporary end to all these activities; but La Villette was finished two years ago, and the plans for Cornillon were redraughted for a 17½ million c.ft. water-gas plant, which economic conditions made a matter of urgency.

COAL HANDLING PLANT.

The Landy Gas-Works and "Le Cornillon" each cover an area of 120 acres, and the site is bounded on the west by the Nord Railway, and on the east by the Saint-Denis Canal. These outside communications are linked up with nearly sixteen miles of railway track within the works, while a high-level line crosses the Avenue de Président Wilson, and serves the canal wharves of Le Cornillon. Coal brought by boat is unloaded by two electric grabbing cranes capable of handling some 650 tons a day; while coal direct from the mine or from the port of Rouen is transported in the Company's high-capacity bogey wagons. Nine steam and two petrol-electric locomotives ply within the works itself.

The wagons are ramped up some 33 ft. above ground level to sidings which extend the full length of the retort-houses; and here the coal is discharged either into an inside range of closed hoppers or an outer series of open hoppers. Various spaces are set aside in the works for the coal reserve, which is unloaded from the wagons by hand and then heaped to a depth of about 10 ft. by Ruston excavators capable of dealing with about 100 tons an hour. The total coal storage capacity is 128,000 tons.

The coal is fed from the bottom of the storage hoppers on to steel belt conveyors, of which there are twenty units running longitudinally under the closed and eight under the open hoppers. These are driven at about 60 ft. a minute, and deal with 50 tons an hour. From these the coal is taken by cross conveyors to crushers which in turn deliver it to the buckets of a Hunt elevator and conveyor. Each of the four retort-houses is served by two crushers and two conveyors; but the conveyors of one house can feed those of the next. The length of each is nearly 1000 ft.; and they are driven at 60 ft. a minute by 25-H.P. motors, and can deal with 50 tons an hour each. All the electric motors driving the various apparatus are controlled from central cabins, one for each house; and so as to avoid any risk of blockage, the controls are so arranged as to prevent any part of the conveying system being started until the portion to which the coal is next delivered is running.



THE DE BROUWER CONVEYORS AND THE COKE SCREENS.

According to the source of supply the coals are sorted out on their arrival into definite hoppers, so that it is possible, by feeding certain specified longitudinal belts on to a particular transverse belt, to obtain a proportioned mixture of the various qualities. As for the outside storage heaps, a Ruston shovel is used to load the wagons, and these are run over the closed hoppers.

The retort-house hoppers which receive the coal from the Hunt elevators are disposed one to each setting, and each has a capacity of 100 tons—sufficient for 24 hours' carbonization.

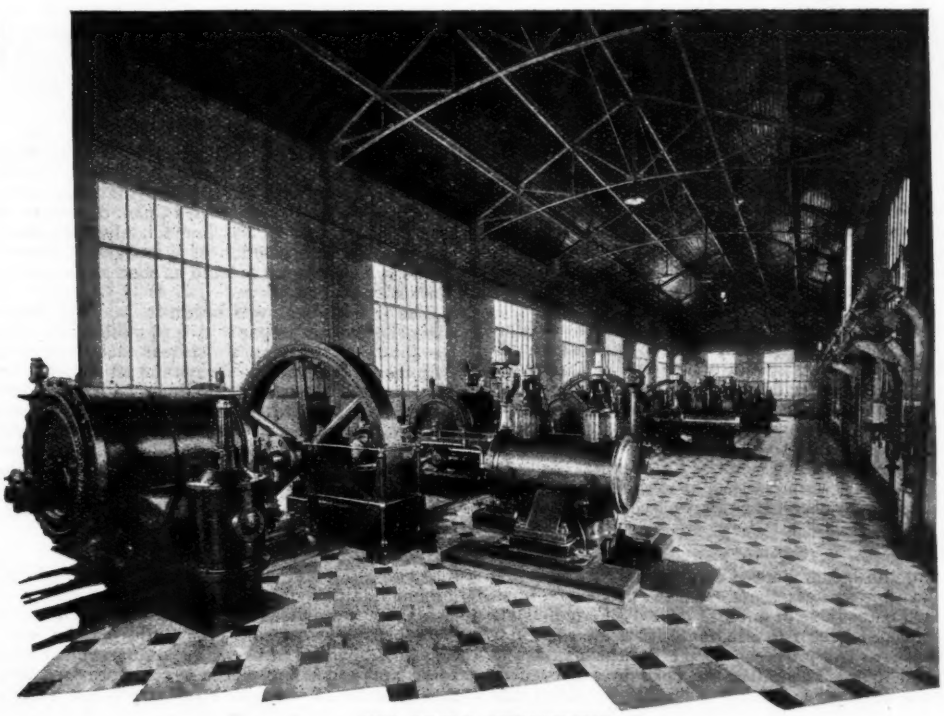
CARBONIZATION.

The coal gas making plant consists of four benches, each having six settings of nines; the retorts being 19 ft. 6 in. long and about 25 in. by 14 in. section. Eight-hour charges of about 12 cwt. are worked. Each setting has its own producer and recuperator. The retorts are charged by a de Brouwer machine and discharged by a modified Sautter-Harlé machine; one of each working two houses. It is of interest to note that the Sautter-Harlé discharger has only one motor (of 12 H.P.) which serves both to traverse the machine at about 120 ft. a minute and to do the discharging. To complete the latter operation takes about 35 secs. The retorts are scurfed once a month, being burnt-out with the aid of a high-speed electric blower. The coke is removed by de Brouwer chains, and discharged into reinforced concrete hoppers of a capacity rather more than the 12-hour coke make of each bench. From these hoppers it is filled into special wagons which convey it to the coke yard for screening and dispatch.

OTHER PLANT.

There are two exhauster houses. That serving Nos. 1 and 2 houses contains: Two Cail exhausters, capacity 3 million c.ft. a day, driven by a 15-H.P. steam engine; an Artige exhauster, capacity 3¾ million c.ft. with 19-H.P. steam engine; and two sets of two Beale machines, total capacity 16¾ millions. The two 35-H.P. engines which drive this section of the plant are fed from an independent steam-raising plant. The exhausting plant for Nos. 3 and 4 houses contains four sets of two Beale exhausters; the total capacity being again 16¾ millions a day. In this case each set is driven by a 40-H.P. engine, steam being supplied from four Babcock & Wilcox boilers. The exhausters maintain a vacuum of 4-10ths of an inch on the hydraulic mains, and deliver at a pressure varying between 19 and 24 in.

The above sectioning of the plant is carried on a stage further, the condensing and washing being effected in two houses. That



THE BEALE EXHAUSTERS.

serving Nos. 1 and 2 retort-houses contains eight Pelouze condensers; the other only four, but of larger capacity. The naphthalene and ammonia scrubbers are of the Kirkham type; anthracene oil being used for the former purpose.

There are six purifying houses, of which the oldest (Nos. 1 and 2) contain 62 small boxes; Nos. 3 and 4 have eight more modern boxes; while Nos. 5 and 6 are very fine examples of the up-to-date "Monobloc" system. In each of the latter houses are two groups of four boxes; each box, fitted with Jaëger grids, presenting an effective surface of 1900 sq. ft. In the old houses revivification is carried out on the same level, handling being assisted by monorail skips; while for Nos. 5 and 6 the oxide is worked on the upper floor of the "Monobloc." The oxide skips are brought up by an electric hoist, and are then taken over by a gantry for distribution over the floor. The boxes are fed direct through canvas shoots.

There are thirteen station meters, housed under a single roof.

Distribution.

The total storage capacity at Landy is 21,709,500 c.ft. There are five single-lift holders of 1,164,900 c.ft. each, giving a mean pressure of 6 in., and three of 5,295,000 c.ft. capacity each. Two of these more modern holders, which have steel tanks, and are guide-framed, have three lifts throwing 5·4, 7·4, and 9·3 in. pressure respectively. The third is a four-lift holder—pressures, 6·1, 7·8, 9·3, and 10·6 in. It is of interest to note that the tank is bellied, which permits of plates of uniform thickness being employed in its construction.

Both low-pressure and high-pressure distribution takes place from the works, the former being through a 39-in. (1 metre) main. For the high-pressure work three Rateau compressors are used running at 3000 r.p.m. and delivering 875,000 c.ft. of gas an hour at a pressure of 35 in. These compressors are direct coupled to 140-H.P. electric motors. The gas is drawn either from the station meters or from the gasholder outlets, and forced through two feeder mains into a special girdle main which supplies the centre of Paris through distributing stations in the Boulevard Malesherbes, Place de la Concorde, Place Vauban, the Trocadéro, Boulevard Montparnasse, Square Cluny, Avenue Victoria, Boulevard Sébastopol. From a central point in the Place du Châtelet communication is maintained with all the works of the Socié é by a double telephone line. The compressors can also be used to boost the direct mains to the Clichy and La Villette Works, so that it may be considered that the storage capacities of all three works are closely interlinked.

The Central Power Station.

The electricity requirements of the whole works are supplied from a central power station which comprises two 70 ft. by 50 ft. shops, with the boiler house (70 ft. by 76 ft.) between them. The boiler house contains eight Niclausse boilers in groups of two, with Bennis mechanical grates and Green economizers, and producing 5000 to 6000 lbs. of steam an hour. Each boiler is fitted with a feed-water injector, but alternatively two pumps can feed the whole installation. The boiler house has water-purifying and steam-condensing plant.

In each engine room are two generators, a transformer, and a switchboard. The dynamos are driven at 125 r.p.m. by two-cylinder tandem horizontal compound steam-engines of 650 H.P. The generators are 400-KW. machines, compound wound for direct current, and at any load maintain a pressure of 250 volts. A 126-unit Tudor battery is connected in parallel on the bus bars; and the principal function of the transformer sets is to control the charging and discharging of the batteries.

Other Services.

The Landy Works take the town supply of river water, and in addition have three wells of their own. The latter are 260 ft. deep. There are three reinforced concrete water towers—two for the well water, capacity 132,000 gallons; one for the river water, capacity 110,000 gallons. The tanks are about 90 ft. above ground level.

There is an up-to-date laboratory on the works, and a machine-equipped range of shops where all repairs of machinery and buildings are carried out; and the stores are extensive. Besides the technical works offices there are houses with small gardens for the accommodation of such of the personnel as are necessary for supervising the essential services. In addition there is very complete lavatory accommodation for the men; the two buildings devoted to this containing bathing facilities for no fewer than 130. It is noteworthy that each workman has his own locker. There is also a complete refectory service and a well-equipped first-aid station.

Coke.

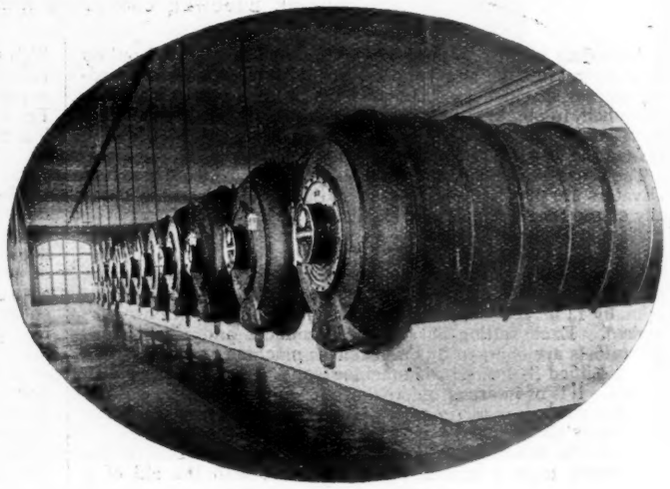
The ashes from the steam boilers contain only a negligible quantity of combustible matter; those from the producers, however, include a high percentage of unburnt coke. The pan-ash is accordingly screened, and the 1 to 4-in. material dealt with in a specific gravity washer. As much as 50 p.ct. of the pan-ash is recovered as useful fuel. Thereafter the coke is conveyed in special trucks to the coke yard, where it is discharged direct into the hoppers of the screening plant, of which there are three duplicated sets. The screened material is afterwards loaded for dispatch by Hunt bucket conveyors.

[The brochure here mentions that, pending construction of the Chemical Works on the Cornillon site, all the tar is sent in tank wagons to La Villette. In view of the exceptional interest which French technicians have since the war been taking in the *Défense Nationale*, we shall expect to find this department well on its way.]

Liquor Treatment and Sulphate Plant.

The daily production of ammoniacal liquor at the Landy Works varies from 30,000 to 40,000 gallons; and this is worked up for sulphate of ammonia, of which over 5000 tons are produced annually. On the Cornillon site, alongside the Canal, the sulphate plant was designed to allow of future extensions when the projected works [see above] are completed. A railway line runs to the plant, which is also connected to Landy by underground liquor and water pipes. There are two 222,000 gallon tanks for the liquor, and one of the same capacity for well water. Two others of similar dimensions contain 53° Bé. sulphuric acid. Power is from the central station, and steam from three Babcock and Wilcox boilers.

The liquor is introduced continuously at the top of three tray stills, while steam enters at the base and in counter-current removes the ammonia; the less volatile salts of the liquor undergoing a lime reaction in the middle portion of the stills. The hot waste liquor runs away through heat exchangers by which the incoming liquor is introduced. The ammonia vapours are then bubbled through sulphuric acid in the saturators. The latter are of lead and have bronze valves; they are nine in number. Special draught arrangements withdraw all fumes from the plant. After draining from the sulphate crystals, the mother liquor, with the necessary addition of sulphuric acid, is returned to the saturators. The sulphate is passed through a rotary drier before storing; being subsequently dispatched in 2-cwt. sacks. The nitrogen content never falls below 20·8 p.ct.



THE STATION METERS.

Water-Gas Plant.

The distribution of water gas was for a long time forbidden in Paris; in fact, it was not until October, 1919, that sanction was obtained for it, with the proviso that the mixed gas supplied should contain not more than 15 p.ct. of carbon monoxide. The Société du Gaz de Paris immediately elaborated a heavy programme for construction of water-gas plants at their various works, which was put in hand as soon as passed by the Municipal Authority.

The Landy plant was begun in January, 1922, and was completed last year. Its capacity is 9⅛ million c.ft. of carburetted gas; but the fact that there are six sets each capable of 1·9 millions a day, means that there is always one set standing by. Each group of apparatus consists of a producer with mechanical grate, a carburettor, a superheater, a washer, two annular and two tubular condensers, a boiler using the sensible heat of both blow gas and run gas, and a second washer. There is a separate blower house and an independent boiler house for power requirements. Coke-handling is entirely mechanical; and all the gas-making valves are hydraulically operated and interlocked to make the plant fool-proof.

Benzole.

Up to 1914, ordinary town gas had to conform to a statutory minimum illuminating standard; and the Landy Works, as occasion arose, were able to enrich their gas by means of a most complete benzole-vaporizing plant. During the war, however, the Société responded in haste to the Government's demand for benzole; and scrubbing plants were improvised and improved as time went on. Landy alone used to produce 60 to 80 tons of crude

spirit a day. By the law passed in August, 1921, the prescribed calorific power of town gas was brought within limits which permit of recovery of the many valuable products—for motor spirit and for the dyestuffs and pharmaceutical industries; and since then steps have been taken to transform the rough war-time plants into thoroughly up-to-date installations. The Landy plant will be sought-out with eagerness.

LA VILLETTE.

From the Société du Gaz de Paris we have received a copy of a handsome book describing this undertaking, which comprises (on an area of over 81 acres) gas-works, residual works, and an experimental station. To the same Company we are indebted for the blocks illustrating both Landy and La Villette. An early opportunity will be taken to publish particulars of the latter.

FRANCE'S IMPORTANT PART IN THE EARLY HISTORY OF THE GAS INDUSTRY.

COMPILED FROM INFORMATION CONTAINED IN "KING'S TREATISE."

WHEN considering the directions in which to look for facts in connection with the early history of coal gas, one's thoughts naturally turn to "King's Treatise on the Science and Practice of the Manufacture and Distribution of Coal Gas"—seeing that this has for so many years been recognized as a standard work in the industry. "King's Treatise" was, in fact, published nearly half-a-century ago, and was edited by the late Thomas Newbigging, M.Inst.C.E., and W. T. Fewtrell, F.C.S. Appropriately, the first of the three volumes into which it is divided opens with a history of gas lighting; and here we find that, though naturally the honour and merit of the first application of coal gas for useful purposes are claimed for William Murdoch, full recognition is made of the large part played by France in the early development of an industry which has conferred incalculable benefits upon mankind. In the year 1792, when residing at Redruth, Murdoch directed his attention to the quantities and qualities of different kinds of gases obtained by distilling various mineral and vegetable substances, and from observations he had made on the burning of coal was induced to try the combustible properties of gas derived from it, as well as from peat, wood, and other inflammable bodies. Being struck with the great quantities of gas they afforded, as well as the brilliancy of its light and facility of production, he instituted experiments with the view of ascertaining the cost of light obtained from such gas.

PHILIPPE LEBON.

In "King's Treatise" there is reproduced the specification of a patent taken out in 1799 by a Frenchman named Philippe Lebon "for a new method of employing fuel (combustible) with greater utility either for heating or lighting, and to obtain certain products therefrom;" and from this the deduction is drawn that Lebon had no definite idea or system with reference to the application of gas, either for lighting or heating. Two years afterwards, we learn, Lebon obtained a certificate of additions to this patent; and in his description he entered with tolerable accuracy, considering the limited knowledge of the chemistry of gas at that period, into the products of combustion. Here, for the first time, it is said, we meet with the word "thermolampe" (a stove to give light and heat). This does not bear out the claim of some that in the year 1786 (and others 1798) Lebon "patented his thermolampe, a kind of stove or oven, in which he distilled wood or coal, in order to obtain the necessary heat for warming dwellings or workshops, and, at the same time, the gas for lighting them."

Indeed, it is urged that even in 1801 Lebon attached but little importance to the employment of gas as a means of lighting; the main substance of the patent being to obtain motive power by the explosion of inflammable gas when intermixed with atmospheric air. He did, however, conclude by describing in the following terms how his gas might be employed for lighting: "The combustion of the inflammable gas is effected in a glass globe supported on a tripod, and cemented in such a manner as to prevent the products of combustion escaping.". He proposes three pipes—one of small dimensions to convey the gas into the globe, another for conveying air into the same, and a third to carry off the products of combustion. Provision is also made that the pipe for the air, as well as the pipe for the obnoxious products, may both be extended to the exterior of the apartment lighted; and taps or valves may be placed on each of these pipes, in order to regulate the supply.

It was in the winter of 1802 that Lebon for the first time exhibited lighting by gas at a house in Paris; and from Winsor's "Traité Pratique de l'Eclairage par le Gaz Inflammable" it is inferred that this was carried into effect according to the certificate of additions previously mentioned. We are told that "the experiment created the greatest wonder and amazement amongst the thousands who witnessed it, and naturally called forth the praise of the local journals." From these the fame of the application or discovery was rapidly diffused by the Continental Press, and thus accidentally came under the notice of F. A. Winsor (a German), who was destined to play a most prominent part in establishing the first Gas Company.

Winsor, who was at that time at Frankfort, proceeded to Paris, to make himself acquainted with the method of obtaining this light; but Lebon proved uncommunicative, and Winsor left Paris with the deepest regret at having failed in the object of his journey, though firmly resolved to find out the causes of such important results. In the following winter, Winsor exhibited at Brunswick, in the presence of the reigning Duke, Charles William Ferdinand, and all his Court, a series of experiments on the products of the distillation of wood, and the means of lighting with gas obtained thereby. It was at the beginning of 1804 that he appeared in London and exhibited, and lectured on, gas light at the Lyceum Theatre. Winsor endeavoured to establish gas lighting in Paris in 1816; and, to forward his views, he translated Accum's "Practical Treatise on Gas Light" into French, adding some original matter descriptive of his operations in London. But beyond lighting an arcade called the "Passage des Panoramas," he was not successful in his enterprise. Paris was not lighted with gas for some years afterwards.

INTRODUCTION INTO FRANCE.

The introduction of gas into France is, "King's Treatise" tells us, intimately associated with the history of the Academy of Music. During the first 150 years of the existence of the opera, the only means of illumination known were necessarily candles, oil lamps, and lamps known by the name of "Locatelli." In June, 1818, however, M. de la Ferte was sent on a mission to London for the purpose of obtaining information as to the application of coal gas to the lighting of theatres. This gentleman having reported favourably upon the new method of illumination, it was decided, in December of the same year, that an account should be opened for 150,000 frs., upon the security of the fund specially appropriated to defray the expenses of theatres; and this fund was to be employed in the establishment of the first Royal Gas-Works. The profits, whatever they might be, to be derived from this enterprise were to go to make up any deficiency in the resources of the Royal Academy of Music. It was at this time that a gasholder in the Rue Richer, Paris, was constructed. Nearly four years later, however—to be precise, in June, 1822—a royal decree was issued to the effect that, considering that the gas-works had attained the end for which they had been established, and that there remained no longer any doubt as to the success of the undertaking, they should be handed over to certain qualified persons, who were thenceforth to carry them on.

In the interval, two gas companies were established for lighting Paris—one, founded by Pauwells, being called the Compagnie Française, and the other, started by Manby and Wilson, named the Compagnie Anglaise. The works of the two companies were erected almost simultaneously, and Paris was lighted for some years by them. Subsequently, at different periods, four other small companies were established at various points in the suburbs to which the mains of the original companies did not extend. Gradually these small works increased in importance, until, the account continues, eventually they became formidable opponents of the original undertakings; but the losses and inconvenience attending active opposition soon became apparent, and the various companies very wisely determined on districting the city, so that each afterwards supplied only a certain locality, a proceeding that was conducive to the interests of all concerned. In 1855 all the Paris companies were united under the title of the Compagnie Parisienne de l'Eclairage par le Gaz, with the exclusive privilege of supplying the city and suburbs for a term of fifty years, when the works, mains, and other apparatus were to become the property of the Municipality.

In 1819, David Gordon and Edward Heard (one of Winsor's assistants at the Lyceum Theatre) had obtained a patent for compressing gas into strong copper or other vessels, fitted with valves to regulate its emission; and this had led to the formation of the London Portable Gas Company, who commenced operations in Clerkenwell. Subsequently, following upon this example, compressed gas was introduced into Paris; but after some years of profitless operations the system was abandoned, and uncompressed gas substituted. For this purpose small holders were placed in the consumer's premises, each having a pipe of communication to the street, on which was a tap and union joint. The gas was conveyed from the works by a van fitted up as a dry holder; and this being connected with the pipe of the consumer's holder, the gas was transferred. The extraordinary expense attending this operation may be conceived when it is stated that each van contained about 300 or 400 c.ft.; and in some instances a journey of ten miles with horse, van, and attendant was made to deliver this small quantity. To supply even a minor theatre for the night, five or six vans of gas were found to be necessary. It is not surprising, therefore, that the concern was unremunerative.

Sir William Congreve, about the year 1824, visited various parts of the Continent with the view of disseminating knowledge of the advantages of gas lighting, and by his exertions the Imperial Continental Gas Association was established. Particulars are found of the early history of the European Gas Company—which is described as "an instance of one of the most successful English undertakings carried on in a foreign country;" but it is

unnecessary to recapitulate this here, as the subject is dealt with in a highly interesting manner elsewhere in this issue.

The Technical Press.

The first periodical devoted exclusively to the spread of information among persons engaged in the supply of gas was established in London in 1847, by George Barlow. This was entitled the "Gas Gazette and Monthly Advertiser;" but after the issue of twelve monthly numbers it was abandoned. It was followed, however, in February, 1849, by the "Journal of Gas Lighting," which was established by Thomas Greaves Barlow, and at first published quarterly, with a supplement on the 10th of each intervening month. In 1852, the first number of "Le Journal de l'Eclairage au Gaz" was published in Paris, and in 1857 a second French periodical, entitled "Le Gaz," devoted to the same subject, was established.

Hydrogen Proposals.

The period round about 1850 was, it seems, exceedingly fertile in the production of various schemes with the view of superseding coal gas. What was regarded by the writer of this portion of "King's Treatise" as the most remarkable of these was the patent of Shepard for a means of producing gases by the action of currents of electricity on water having chemical matter dissolved in it. According to a prospectus issued in Paris preparatory to the formation of the Compagnie Générale du Gaz Electrique for working this patent, it was stated that hydrogen could be produced by the process at 3¼d. per 1000 c.ft.; and this, in order to be available for lighting, was afterwards to be enriched by hydrocarbons. The capital proposed for the enterprise was no less than two millions sterling; and, "as invariably happens under like circumstances, the scheme had its scientific supporters, among them some eminent French *savants*, who gave the most flattering accounts of the process. However, on impartial investigation, it was ascertained that in the decomposition of the water and ingredients (the 'chemical matter dissolved' therein being oxalic acid and sulphuric acid) one-third of the resulting gases consisted of carbonic acid, the other two-thirds being hydrogen, thus forming a compound almost valueless for the purpose intended, while the cost of production was more than one hundred times greater than was stated in the prospectus. In consequence of this discovery the gigantic bubble exploded."

Laming's Oxide Purification Process.

Laming, who was at that time residing near Paris, in February, 1849, obtained a French patent for various means of purifying gas, and in describing the process said: "In the fifth part of this invention, I extract from illuminating gas all the sulphuretted hydrogen that it contains, by means of the hydrated peroxide of iron. The sixth part of this invention consists in renewing the hydrated peroxide of iron, after it is converted into the sulphuret of iron by absorbing the impurities of the gas; for this purpose I expose it to the action of the atmospheric air." He further proposed to mix the oxide with sawdust and other like substance, so that the gas could pass freely through the material. The writer comments: "Probably Laming was not aware at the time of the vast importance of his discovery; but whether from this or other causes, he made no application for an English patent. Nevertheless, to him is due the merit of being the first inventor of renewing spent oxide by exposure to the atmosphere."

Carbonization.

Among the early workers, Letreust, who was the Manager of the Vaugirard Works at Paris, carefully studied the various methods of heating retorts, specially directing his efforts to means of economizing the fuel, to avoiding the great loss of heat at that time occasioned by the passage of hot gases up the chimney, and the prevention of loss by radiation from the front of the furnaces. By the use of a special device, he secured an economy of 15 p.ct. of the fuel employed in the furnaces, and at the same time increased the production of gas per ton of coal. Mention is made of the publication, in 1837, of a "Traité sur le Gaz," by Merle; and also of a "Traité d'Eclairage par le Gaz," by Schilling. There is next a description of the apparatus devised by Pelouze and Audouin to cause the deposition, in a liquid state, of the condensable impurities in coal gas; and then we learn that the progress of the exhauster was very slow in England, the apparatus being practically applied at some of the larger works in France several years before it was generally used in London. Another Pelouze and Audouin apparatus is illustrated, this time for the purpose of eliminating the soluble impurities in gas by the reaction of liquid solvents put in suspension therein in a vesicular or molecular form.

Gasholders.

In the year 1782, Lavoisier presented a communication to the Académie des Sciences on "The Manner of Augmenting Considerably the Action of Fire and Heat in Chemical Operations." In this he illustrated and described a square gasholder (as it is now termed) working in a square tank filled with water, and provided with two pipes for the inlet and outlet; the holder being suspended by a chain, which passed over the curved end of a balance lever, and was counterbalanced by ordinary weights placed in a scale. At the time of the invention, the apparatus was intended simply for containing oxygen for blowpipe purposes. His assistant Meusnier, in the same year, communicated to the Académie a suggestion for an apparatus for storing gas in large quantities, for use in the laboratory. "King's Treatise" says "it is generally, but erroneously, stated that Lavoisier invented the gasholder in 1789." The circumstance which may have led to this error is probably the fact that his work "Opuscules Chymiques et Physiques" was published during that year, and in this he described his invention in the following words: "I have given the name of gasometer to an instrument of which I am the inventor, and had made with the object of producing a continuous and uniform supply of oxygen for experiments of fusion. Since then, M. Meusnier and myself have made considerable corrections and additions to our first trials, and we have transformed it, in a manner of speaking, to be a universal instrument, which it would be difficult to dispense with whenever it may be desirable to make experiments of rigid exactitude. The name of the instrument sufficiently indicates that it is destined to measure the volume of gas." Thus was produced the gasholder.

Quotation is made of some "Notes on French Practice in the Construction of Gasholder Tanks and Gasholders," which previously appeared in the "Journal of Gas Lighting," and were an abridged translation by Dr. William Pole of a mémoire by M. Arson to the Société des Ingénieurs Civils of Paris. It is remarked that "the Engineers of the Compagnie Parisienne d'Eclairage et de Chauffage par le Gaz, among whom M. Arson holds a distinguished place, have devoted much attention to the various points which enter into the design and construction of these important portions of a gas establishment."

Gas-Engines.

There are many other references in "King's Treatise" to French apparatus for the manufacture and utilization of gas, but these notes must be brought to a close by mention of gas-engines. In 1864 Mr. Goddard, of Ipswich, in a paper read before the British Association of Gas Managers, gave a detailed description of Lenoir's improved engine, which, it is said, was at that time the only practicable gas-engine that had been brought before the public. Lenoir's first patent was taken out in 1860, and the second in the following year. One of these engines was to be seen at work in the Exhibition of 1862, and was that described in his first patent.

THE NEW COATBRIDGE HOLDER.

Opening Ceremony.

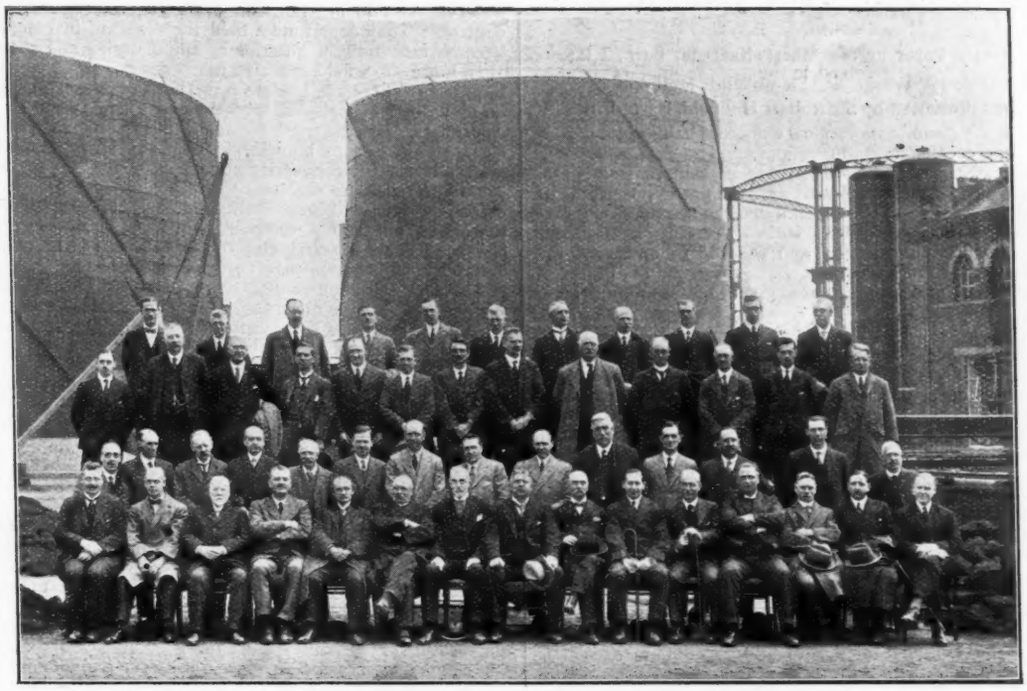
In last week's issue [*ante*, p. 744] some particulars were given of the new three-lift spiral-guided holder erected for the Coatbridge Gas Company by Messrs. Robert Dempster & Sons, Ltd., of Elland, which was officially inaugurated on the 4th inst.

About noon on that day, a large company of prominent gas managers drawn from all parts of Scotland assembled at the works, where the ceremony of inaugurating the holder was carried through. Mr. J. W. Broadhead, M.Inst.Mech.E. (representing Messrs. Robert Dempster & Sons), asked Mr. A. S. Legat (the Chairman of the Coatbridge Gas Company) to accept from his firm a silver rose bowl, as a memento of the occasion, and called upon him to turn on the supply from the new holder to the town.

Mr. Broadhead welcomed all who had accepted the invitation extended to them to inspect the new holder. It might not be without interest to know, he remarked, that it was the first fitted with the "Elland" rail and "Elland" ball-bearing carriage in Scotland, and the second in Great Britain. The new type of holder had been introduced only last year, but orders for seven had already been placed with the firm. One obstacle which had faced them was that the rails were difficult to roll, but this had happily been overcome. He particularly drew attention to the ladders on the holder, a speciality of his firm's, and further mentioned that the holder was of sheet iron, the thinnest plates being 11 gauge, and that its capacity was 320,000 c.ft. He had the greatest pleasure in asking Mr. Legat to accept a rose bowl as a souvenir of the occasion, and he hoped that gentleman would long be spared to fulfil the responsible duties appertaining to the office of Chairman of such an enterprising and prosperous Gas Company. It only remained for him to ask Mr. Legat to turn on the gas supply from the new holder to the town.

Mr. Legat, after complying, said, on behalf of the Coatbridge Gas Company, he was pleased to see that so many had taken the opportunity of inspecting the new holder. On inspection they would find it was a good job well done by Messrs. R. Dempster & Sons. The Gas Company were satisfied, and so were the firm of contractors, and he trusted the result of that gathering would be an access of business to Messrs. Dempster, for undoubtedly they were the firm to do such a job for anybody. He thanked Mr. Broadhead for his gift, which he presumed was really a compliment to the Gas Company. Between the Company and the firm the most cordial relations had subsisted. The firm had brought to bear on their work both technical ability and high efficient management; and the result, as he had said, was a thoroughly good job, in keeping with their reputation. Further, the work had been completed practically to time, which was not so usual with contractors.

After the visitors had made a tour of inspection of the works, which are not unfairly described as probably the most up-to-date in the provinces of Scotland, an adjournment was made to the Lesser Town Hall, Coatbridge, where a representative company of guests partook of the generous hospitality of Messrs. Robert



AT THE OFFICIAL OPENING OF THE "ELLAND" PATENT BALL CARRIAGE SPIRAL-GUIDED GASHOLDER AT COATBRIDGE.

Dempster & Sons, Ltd. The chair was occupied by Mr. J. W. BROADHEAD, and he was supported by Mr. A. S. Legat, Provost Kirk (Coatbridge), Mr. Bailie H. Martin (Coatbridge), Mr. Laurence Hislop (Uddingston), Mr. George Braidwood (Gas Engineer, Coatbridge), Mr. J. W. Napier (Alloa), Councillor J. Tennent (Coatbridge), and many others prominent in civic and municipal enterprises in different parts of the country.

The toast of the Coatbridge Gas Company was given by Councillor J. TENNENT, who commented on the well-known enterprise of the Company—an enterprise that had won for them recognition throughout Scotland. The affairs of the Company had been most ably managed by Mr. George Braidwood (the Resident Gas Engineer), and he was guided by a popular townsman, Mr. A. S. Legat, the esteemed Chairman of the Company. For a long time the Coatbridge Gas Company had been famed for their progressive policy, and during the *régime* of Mr. Braidwood there was no disguising the fact that the works had been practically revolutionized. As an instance of the progressive spirit which permeated the Directors, the old horizontal settings of retorts had been taken out, and up-to-date verticals installed. The outcome of this was that they handled all the raw material entirely by mechanical means, without any manual labour being involved. Further, as showing their enterprise, they had extended their mains to the various surrounding districts, and that day their latest activity had been disclosed in the inauguration of a spiral-guided holder fitted with the "Elland" patent ball carriages. He supposed all the guests would be glad to hear that the contract had been creditably carried through by the firm; and the job was one which had engaged the personal supervision of Mr. J. W. Broadhead, their Chairman that afternoon. He referred in appreciative terms to the happy relationship which always existed between members of the Coatbridge Town Council and the managing official and the Directors of the Company. Personally he was very pleased to see Provost Kirk sitting alongside the Directors of the Company that afternoon, and he hoped the cordial good feeling between the Town Council and the Gas Company would long continue.

Mr. A. S. LEGAT, in the course of his reply, said it might be news to many of the guests to learn that prior to 1843 Coatbridge was, at least to a partial extent, lighted with natural gas from the bowels of the earth. Curiously enough, the gentleman who introduced that innovation was of the same name as the proposer of the toast. Somewhere about the year 1843, the natural gas supply failed, and a number of public-spirited citizens developed the idea that there should be more light. Accordingly, steps were taken for the starting of a Gas Company with a capital of £4000; and for ten years following the flotation of the Company the price of gas was 8s. 6d. per 1000 c.ft. He had not been able to discover any record of what the sales were in 1843 and for the ten years following, but in 1854 the consumption was 3,780,000 c.ft., and the price was 6s. 2d. From that time onwards there appeared to have been steady progress, because in 1863 the consumption was 9¼ millions, and the price averaged about 4s. 6d. In 1877 the original Company were taken over by the present statutory Company, with an authorized capital of £44,000, and the works which the guests had seen that day were erected. In 1880 the sales had increased to 32½ million c.ft., and the consumption in 1914 had advanced to 235 millions, while the cost had gone down to 1s. 6d. per 1000 c.ft. For the current year, charging by the therm, the Company anticipated that the sales would be in the vicinity of 1¼ million therms. The present charge of 7d. per therm was equivalent to 2s. 9½d. per 1000 c.ft. The gas was 435 B.Th.U. The capital expended to date by the Company amounted to the considerable total of £175,000. In their endeavour to keep abreast of the times, it was interesting to note that during the past few years the Company had expended a sum of £80,000 in improving the works generally, and in an extension of the mains. At one time Coatbridge had enjoyed the proud distinction of supplying the cheapest gas, not only in Scotland, but in Great Britain, and they still had hopes of getting back again to that position, if only trade and employment became more normal. They believed in the idea of a community of interest in the Coatbridge Gas Company, and their aim was to supply gas as cheap as possible, to the benefit of both consumers and shareholders. Speaking for himself he was an optimist regarding the future of the gas industry. He reciprocated the kindly remarks of Councillor Tennent in regard to the cordial relations subsisting between the members of the Coatbridge Town Council and the Directors of the Gas Company.

Ex-Bailie H. MARTIN proposed "The Contractors," coupling with the toast the name of Mr. Broadhead. He reminded those present that Mr. Broadhead represented the well-known and reputable firm of Messrs. Robert Dempster & Sons, Ltd. It was common knowledge that they did a lot of work associated with the manufacture, installation, and erection of gas plant; but the design of this plant was only one of numerous engineering specialities handled by them. The "Elland" patent ball carriage was a speciality of Messrs. Robert Dempster & Sons, and, as a matter of fact, he believed it was designed by a son of Mr. Broadhead. It must surely be a pleasure to that gentleman to reflect that his son was following in the father's footsteps, and that he was capable of this invention. Speaking as one of the Directors of the Coatbridge Gas Company, he should like to say it had been a pleasure to be associated with a firm of such standing. In this holder Coatbridge had got a first-class engineering job.

The CHAIRMAN, in acknowledging the toast, said he was gratified at the complimentary reference which Ex-Bailie Martin had made to his son. Personally, he felt very proud indeed of his son's invention. But for illness he would most certainly have been with them at Coatbridge that afternoon. Happily he was on the road to recovery now, and he hoped he would soon be back at business again. Perhaps he might be permitted to express the hope that the representative gas managers who were included in the company that afternoon had been pleased with what they had seen. Speaking for his firm, he thought they had every reason to feel proud of this new three-lift spiral-guided holder. Mr. Broadhead made a number of complimentary allusions to Mr. Braidwood and Mr. Legat. He took the view that Mr. Braidwood was to be heartily congratulated on looking ahead and realizing that, if they wanted an efficient holder, they must have thick sheets, and moreover he seemed to be convinced on the point that iron sheets had a longer life than steel. It was a pleasure to hear of the happy relationship which existed between the Gas Company and the contractors responsible for carrying out the work. Mr. Braidwood had made a visit to his firm's works, and satisfied himself that he was getting hold of the right thing for the purpose he had in view. The Gas Company and Mr. Braidwood particularly had been most considerate to the firm's workmen, and he was grateful for the kindness that had been shown.

Other toasts were "the Town and Trade of Coatbridge," proposed in a racy, informative, and reminiscent speech by Mr. J. W. NAPIER, and acknowledged by Provost KIRK, and "The Resident Manager of Coatbridge," proposed by Mr. LAURENCE HISLOP, and responded to by Mr. BRAIDWOOD. In the course of his reply, the latter gentleman remarked that the success of the Coatbridge Gas Company had unquestionably been due to the capable Directors of the past and the present management, which, with the conditions that prevailed in Coatbridge, was no easy job. He had been fourteen years in the district—nine of which had been spent as Manager—and he had been given every encouragement to forge ahead.

The toast list was agreeably interspersed with songs contributed by local entertainers.

METHODS IN FUEL ECONOMY.

Extracts from a Paper by Sir Robert Hadfield, Bart., F.R.S.

A paper entitled "Works Problems and Methods in Fuel Economy" was presented by Sir Robert Hadfield, Bart., F.R.S., at the Empire Mining and Metallurgical Congress held on June 3—6. The paper was divided into four sections. The first, which was introductory, concerned itself with the economic importance of fuel economy as a result of the war, and the nature of problems met with in the works; in the second, general considerations regarding heat balances were dealt with. The third section was devoted to specific applications; and the fourth discussed the temperature factor in fuel economy. The paper is full of interest and of great value; and we propose to give a few extracts from it.

CHIMNEY LOSSES.

Causes of excessive loss in furnaces may be traced to inefficient combustion, defects of furnace design, or unsuitable operation either as to loading or to driving. The chimney loss is made up of the loss of sensible heat of the waste gases, and the loss of heat as unburnt combustible. The former may vary from upwards of 40 p.ct. in some operations, down to 5 p.ct. of the heat supplied. The latter may exceed 10 p.ct. in bad practice. It is in the determination of the losses of sensible heat in the products of combustion that the measurement of the temperature of the waste gases becomes all-important. Accurate pyrometry (using those words with a full sense of their meaning) and a thorough survey of the question of stratification of the gases in the flues are of paramount importance if the full value of its important aid to economy is to be realized. [This question of stratification has been exhaustively explored by the engineers of the United States Bureau of Mines, and their observations are reported in Bulletin No. 97.] Knowledge of the composition of waste gases in combination with pyrometer measurements is the key to complete combustion, and of the proper passage of the gases through the furnace system, thereby ensuring that the maximum opportunity for heat transfer has been given. Satisfactory controlling instruments for this purpose—namely, CO_2 recorders and recording pyrometers—are now obtainable. Carbon-monoxide recorders are also available, but it cannot be said that their use is appreciable in extent.

By the use of graphical methods, the results of pyrometric measurement and gas analysis may rapidly be converted into terms of heat lost. A series of curves showing the relation between CO_2 and excess air and the temperature of the gases having been plotted for the range of composition of the fuels commonly in use at a given installation, it only becomes a matter of brief reference to these. The laborious calculations otherwise involved are finished with, once the charts are prepared. In the case of coal, for a wide range of heating value of the fuel, (say) from 11,000 B.Th.U. to 14,400 B.Th.U. per lb., the possible error is of the order of 1 p.ct., and does not exceed 2 p.ct. of the total heat input—a result within the requirements of practice. The same applies in the case of producer gas, provided excessive variations of composition are not met with, which themselves would be an indication of faulty practice. In order to make use of such charts, an approximate knowledge only of the composition of the fuel is necessary.

ERRORS IN PYROMETRIC MEASUREMENTS OF GASEOUS STREAMS.

It need hardly be pointed out that any scientific instrument is valueless unless care in use is observed, and periodic check of accuracy carried out. This applies in particular to the thermo-couple type of instrument. There are other forms of instrument which may be used (notably, mercury thermometers protected in an iron sheath), but for routine work on large installations there is no type to equal the thermo-couple. The recording or indicating instrument may be placed at the most convenient position; and it is only a question of wiring-up to enable observations to be taken at any selected points. In measuring with a pyrometer the temperature of hot gases surrounded by colder surfaces, the temperature indicated by the instrument is always too low. Though heat is imparted to the exposed element by the hot gases, heat is also lost from the measuring instrument to the colder walls of the furnace or flue by radiation. The rates of conduction and radiation and the error are diminished as the element is made smaller, but strictly speaking, for absolute accuracy, observations would have to be extrapolated to an instrument of insignificant size. The chief cause of such discrepancies arises from the necessary tubes which must be used to protect the vital parts of the pyrometer. Actual errors vary with conditions. The United States Bureau of Mines investigations found 20° Fahr. to be the average error in boiler practice. On the other hand, the error due to the stratification of the gases may be of the order of 1 p.ct. of CO_2. A necessary safeguard is an exploration of the stratification in the flue in which the observations are to be taken. This applies to the observations both of temperature and of gas composition.

RADIATION, CONVECTION, AND CONDUCTION LOSSES.

As to the amount of loss of heat by conduction, convection, and radiation from the settings, this is usually in practice arrived at by difference; but, for the accurate estimation of relative losses, some form of thermometric measurement is necessary. Such observations do not fall into one's general scheme of routine control. They constitute a field for separate investigation, and become essentially a question of initial design and construction. It is, however, a field in which much data of an absolute type are required. There are two main methods of attacking the subject on an industrial scale—one by the use of some form of radiation calorimeter, and the other by determining the temperature of the surfaces, and, from a knowledge of the emissivity constants of the materials and the convection conditions of the surrounding atmosphere, to calculate the heat lost by these means. In a paper before the Iron and Steel Institute in 1919 (Hadfield and Sarjant) there was outlined a method which gives satisfactory results from the practical standpoint. The chief difficulty in the second method is in obtaining contact instruments which when used do not become erroneous. The method merely requires a series of surface temperature observations, and preferably a knowledge of the internal surface temperatures as well. The results are converted into terms of heat units by the use of a chart.

GAS QUALITY FOR STEEL HEATING.

The first consideration is, of course, to obtain the heat units in the gaseous form at the lowest possible price. We may exclude for the present the heavy capital expenditure sunk in existing plant designed for gas of the present standards, and look into the future. The constituent of all gaseous fuels which is of the most value in the heating of metals is carbon monoxide. Its high radiating capacity, low rate of flame propagation, and beneficent action in the prevention of decarburization of steel, make it pre-eminently suitable. It produces a "soft" flame, so desirable in metal heating. Hydrogen is looked upon unfavourably, as by reason of its low radiating capacity and the oxidizing effect of the product of its combustion (steam) on ferrous metals at a high temperature, it produces a "cutting" flame. Methane and its homologues are advantageous, as they have a stabilizing effect on the tendency to back-firing; so too are the unsaturated hydrocarbons, ethylene and its homologues. These richly carbonaceous gases are the more desirable as the contained ratio of carbon to hydrogen increases. Again, there are formed in a hydrocarbon flame burnt with a deficit of air particles of soot, which are slowly burned, for it can be shown by taking into consideration the size of the particle that the chance of each particle coming into contact with sufficient oxygen to complete its combustion becomes remote in a reducing flame and under the cooling influence of the metal mass. This soot plays the dominant role in the prevention of decarburization of hard steel.

At the same Congress, F. S. Sinnatt, M.B.E., M.Sc., F.I.C., and H. E. Mitton, M.Inst.C.E., F.S.I., read a paper on "The Preparation of Coal for the Market," in which are described various methods of coal washing, and the results obtained by the different processes. The successful colliery company of the future, the authors state, will be required to win the coal economically, pay a just remuneration for labour, and at the same time deliver the coal to customers in the sizes required and as free from ash as is economically possible. It is essential that the treatment of the coal at the face and upon the surface should be given the fullest consideration. The subject must be dealt with as a whole, and the projects for the winning of the coal in the future should have a counterpart in the methods of purification. No individual process of coal washing or purification may be singled out as being suitable for all purposes. Each colliery must receive separate consideration, and the characteristics of the various coals, allied with the chief requirements of the consumers, must be carefully studied before a system is adopted. It would appear to be necessary for some collieries to combine a number of processes in order to recover the maximum amount of coal. There is little doubt that at the present rate of progress the time is not far distant when every colliery will possess a modern system of coal preparation. It would be of value to the industry if statistics were available which would indicate the great advances taking place in coal preparation and the districts where such washed grades can be obtained. From an approximate surmise based upon limited information, the amount of coal washed is not less than 25,000,000 tons per annum, based upon five seven-hour days a week.

In view of the importance of this matter, the authors suggest that some machinery should be set up to collect these statistics. The information would be of practical value to the industry and the consumer; the coal industry would benefit, as the figures would indicate the different types of preparation suitable for the coals mined in various districts. It would be of importance in indicating to unsuccessful companies a possible reason for non-success, and it might provide the information by which a colliery with restricted markets could enter those of its more successful neighbours.

Benzene, "The Times" points out, was first prepared in the Royal Institution laboratory by Faraday, who announced his discovery to the Royal Society on June 16, 1825. The managers of the Royal Institution, in association with the Chemical Society, the Society of Chemical Industry, and the Association of British Chemical Manufacturers, have decided to celebrate the event on June 16 next year. The arrangements are in charge of a Joint Committee of the four bodies.

THE WORK OF THE WESTMINSTER TECHNICAL INSTITUTE FOR THE GAS INDUSTRY.

The Opportunities Afforded to Gas Employees.

IN a world of doubts and queries it is at all events true that education of the worker engenders an intelligent interest in his work and widens his capacity of performing it. It is becoming increasingly recognized that the gas industry will in the future be best served by those who have inherited or acquired what may be termed a scientific mind; and this is true in degree from the humble syphon pumper in the provincial gas-works to the one who rules the destiny of a large undertaking in the Metropolis. A good gasfitter, for example, is a man who is capable of coping with situations outside the routine work in which he has developed skill. On the district, times without number, he will be called upon to deal with something "slightly different" from his routine work; and his method of attack on the new problem, and the efficient manner in which he encounters the difficulty, will in large measure depend on whether he has a scientific mind. Do not let this be confused with the acquired knowledge which is merely a mass of facts. It is agreed that the fitter is not required to know the formula of (say) geraniol, or to be able to talk fluently on the laws of radiation. What is required is the right outlook towards his work. It is this outlook which the Westminster Technical Institute endeavour to stress; and in this respect a great deal of encouragement and material assistance has been, and is still being, given by the Gas Light and Coke Company.

THE APPRENTICE SCHEME.

It is not the purpose of this article to detail the various curricula of the Institute, but rather to afford some indication of its value and importance to the gas industry. The apprentice scheme was formulated by the Gas Light and Coke Company, but there are also students from the South Metropolitan, the South Suburban, and the North Middlesex Gas Companies. These day-classes for gas-fitting apprentices are an interesting example of co-operation between a Local Education Authority and a large industrial organization. The Gas Light and Coke Company take into their employment about twenty gasfitting apprentices every six months. Their practical training is provided by the Company in a special workshop on their own premises, and the County Council undertake instruction in English subjects, mathematics, science, drawing, physical exercises, and the principles underlying the practice of gasfitting. For this purpose apprentices attend the Institute for three half-days per week during the first six months of apprenticeship, and for one whole day per week during the succeeding twelve months. During the next six months they attend during one half-day and also for a minimum of four hours per week in the evening. After this, attendance is carried on entirely in evening classes until the expiration of apprenticeship, except that at some time during this period each apprentice attends the Institute for a full-time course of twelve weeks' instruction in joint-wiping. The instruction in mathematics, drawing, and science is in the hands of one teacher. This provides an excellent opportunity of co-ordinating the work in these subjects, and of showing their interdependence and their relation to the more specialized instruction in gasfitting.

Recently we visited the Institute, and were impressed with the keen and industrious way in which the students were tackling their work. In the gas-fitting workshop the apprentices of the Gas Light and Coke Company were making all types of joints—underhand, branch, upright, and rolled—and were acquiring efficiency in the "Amalgalene" process. All the jointing work done is tested under pressure.

THE GAS INSTITUTION'S EDUCATION SCHEME.

The Advisory Sub-Committee of the Westminster Technical Institute have given careful consideration to the Education Scheme arranged by the Institution of Gas Engineers, in conjunction with the Board of Education. While they regard the scheme as marking a distinct advance in the provision of facilities for the examination of employees in the industry, they express their regret that no provision has been made for the award of trade certificates to employees of the gasfitter type. The Committee suggest that, given the necessary ability and experience, those who have served an apprenticeship, and subsequently been engaged in the actual practice of gasfitting and gas supply, are most suitable for promotion to positions entailing the work of supervision and inspection; and they emphasize that fitters should be encouraged to pursue organized courses of study, combining the practical aspects of their daily employment with a preliminary scientific training which will enable the more able to undertake the advanced work necessary for their promotion. The Committee think that, in the absence of a "ladder" which will encourage employees to undertake in their earlier years the educational preparation necessary to the pursuit of study under the scheme, there will be a lack of candidates for the examinations promoted by the Institution of Gas Engineers.

We certainly agree that in industrial education there is a pressing need for the stimulus which would be derived from the inauguration of schemes of examination having as their basis an insistence on proficiency in ancillary or cognate subjects as a condition of the award of technological certificates; and it is with interest that we record the suggestion of the Advisory Sub-Committee that the Institution of Gas Engineers should consider the establishment of examinations for the award of group course certificates, differentiated as trade certificates and professional certificates.

EXTENDED FACILITIES OF THE INSTITUTE.

Within a few yards of the Institute there is a roomy building which formerly served as a vicarage. This has been acquired by the London County Council; and it is proposed to convert the whole of the ground floor into gas workshops and laboratories, and so afford ample scope for the education of gas employees.

At present the work in connection with the gas industry is carried on by the undermentioned teachers and lecturers whose training and experience have admirably fitted them for the work. For Grade I. of Gas-Fitting and Supply, Messrs. P. Smithers and F. B. Bellamy are responsible. The work for Grade II. is undertaken by Mr. W. Dieterichs. The lecturer in Gas Supply III. is Mr. E. L. Oughton; Mr. J. Hewett and Mr. F. C. Smith are in charge of the Gas Supply Laboratories; the courses for gasfitter apprentices are under the supervision of Messrs. Steed, Smithers, Snell, and Ferne; and Mr. Smithers and Mr. Tutton direct the gasfitting workshop practice.

The industry has been well served in the past by the Westminster Technical Institute; and with the extended facilities, still further advantages and opportunities will be available in the future.

ISLE OF THANET GAS COMPANY.

A Century of Progress.

Incorporated by Act of Parliament which received the Royal Assent in May, 1824, the Isle of Thanet Gas Light and Coke Company have recently been celebrating their centenary, in a manner which was indicated in the "JOURNAL" for June 4. In connection with this happy occasion, there was distributed a brochure, admirably got up, full of interesting historical facts, and evidently compiled with much labour and care. From this some extracts are now taken, beginning with the first page, containing the following names:

Directors: WALTER HILLS (*Chairman*).
WILLIAM TOMLIN, J.P. (*Deputy Chairman*).
WILLIAM YOUNG, WILLIAM BOOTH REEVE, M.B.E., J.P., WILLIAM J. MERCER, J.P., JOHN A. GRIBBLE, E. O. SKEY, J.P.
J. M. CAMPBELL, *Engineer and General Manager.*
A. J. STICKELS, A.C.I.S., *Secretary.*

The initial lighting took place in Ramsgate on Aug. 30, and in Margate on Sept. 2, 1824; and in the "Kentish Gazette" of Sept. 7, 1824, it was stated: "The pier appeared most brilliant, being lighted with 24 large lamps. The lighthouse at the end of the pier is to be lighted with gas shortly. The shops and private houses are pretty generally lighted." To Mr. Joseph Hedley must be conceded the honour of conceiving the idea, formulating the scheme, and installing the plant for the supply of gas in Ramsgate and Margate, as his name appears in many of the records both before and after the formation of the Company. A cast-iron superscription plate (discovered during some recent excavations) bears the following words: "These works were projected and erected by Joseph Hedley, London, 1824." Mr. Hedley in 1824 disposed of both works for the total sum of £13,500; and his letter, after reciting the character and extent of the plant, states that "the lighting apparatus be equal for the supply of gas for 500 lights at each town," which is the earliest intimation of the capacity of the original works.

Mr. Nathaniel A. Austen occupied the position of the first Chairman (and Treasurer) of the Company from its inception until May, 1840, when he resigned and was succeeded by Mr. Richard Tomson, Jun., and Mr. J. O. Burgess as Treasurer. Mr. Tomson retained the Chairmanship until 1856, when owing to defective eyesight he resigned, but remained on the Board, and Mr. H. Curling was appointed to the chair, which he retained until his death in 1887, being followed by his son, Mr. William Curling, who resigned in 1902. Then Mr. Lazarus Hart was elected, he retaining the position until 1917, when, owing to his death, Mr. Walter Hills, the present Chairman, was appointed. In 1869, Mr. Thomas C. Fuller was appointed Clerk to the Company, and afterwards became Secretary, retaining this position until 1914, when he resigned after 45 years' service, and was succeeded by the present Secretary, Mr. A. J. Stickels.

The first association of the Jones family with the Company as Engineers was at the beginning of 1865, when Mr. Robert Jones, Engineer to the Commercial Gas Company at Stepney, was asked to quote his terms for inspecting the works at Ramsgate; and from time to time he was consulted as to alterations and extensions, and advised the Directors as to tenders. Mr. Jones' introduction to Margate was about two years later, when he was asked to survey the works, confer with the Directors, and report; and he (followed by his son, Mr. H. E. Jones) acted as Consulting Engineer for both stations, until the appointment in 1898 of Mr. James Dougall as Engineer, who succeeded Mr. H. H. Jones after his four years of service—the latter having followed Mr. F. Doughty, who for 55 years had faithfully occupied the position of lamplighter, &c., then foreman, and latterly Manager at the Margate Works. Mr. Dougall's services extended over a period of

seven years, and he was succeeded in 1905 by Mr. F. A. Winstanley, who was superseded in 1909 by Mr. J. M. Campbell, who is still the Engineer and General Manager of the Company.

The events leading up to the disposal of the Ramsgate Works to the Local Authority were spread over a considerable period. The first evidence of any desire of the Ramsgate inhabitants to purchase the Company's undertaking within the Ramsgate area occurs at the end of December, 1874, when a reply was sent to a Mr. Jackson, declining to call a special meeting of the shareholders to discuss the question; and some nine months elapsed before the matter was again referred to, by the Town Clerk intimating that a Committee had been appointed by the Local Board to consider and report on the project of the sale of the works to them. To this the Directors replied that "they have neither the power nor the desire to sell their works," but that they would consider the proposal if made. Lengthy correspondence ensued, and Mr. R. Jones was consulted on the subject by the Company, who took legal advice on the desirability of making application to Parliament for further capital powers, and *inter alia*, to include a provision for the disposal of the Ramsgate Works by agreement. The Local Board offered the sum of £30,000 for the goodwill, rights, privileges, and the whole of the property and plant within the parishes of Ramsgate and St. Lawrence, including compensation and expenses. This, however, was declined by the Directors. A Bill was promoted by the Ramsgate Local Board for compulsory acquisition of the works, and the Company also proceeded in a similar direction, during the 1876 session of Parliament. The former Bill, however, was rejected after a four days' inquiry, and that of the Company withdrawn. In the following Parliamentary session each party promoted a similar Bill to that of the previous year, with the result that the Bill of the Local Board was defeated, and the preamble of the Company's Bill proved. On April 28, 1877, a special Board meeting was held, and a preliminary agreement sealed, determining the basis on which the Ramsgate and St. Lawrence portion of the Company's undertaking would be acquired by the Ramsgate Local Board; and ultimately the Thanet Gas Act, 1877, was passed.

The effect of the disastrous European War was more severely felt in Thanet than in any other part of the country, through enemy air incursions, involving an exodus of inhabitants, and the absence of the usual flow of visitors. As a result, the Company's output of gas diminished by over 50 p.ct. and the continually increasing costs of wages, coal, and other materials, in addition to the fluctuations in the market price of residuals, rendered it necessary to increase the charge for gas with regrettable frequency during those years. These difficulties were not ended on the termination of the war, as coals remained very costly, and were aggravated at a later date by the three-months' miners' strike. This necessitated the purchase of coals from the Continent and the United States, in order to cope with the demand, and again involved an advance in the price of gas, which has since been substantially reduced.

There follows in the brochure an account of the plant at the Margate Works and sundry notes of interest. For these our readers are referred to Vol. 158 of the "JOURNAL," pp. 503 4, where was recorded the spring visit of the Southern Association to Margate, during the presidency of Mr. J. M. Campbell, in 1922. We remark, however, that the mileage of low-pressure mains has since increased from 37 to 43, and that a minimum pressure of 30·10ths is now maintained during the night all the year round, in place of 22·10ths as then practised. Further, a "Columbus" coke separator, with a capacity of 2 c.yds. per hour, has been installed; and the sulphate of ammonia plant has been improved by the addition of neutralizing and drying facilities. Another interesting piece of work has been effected in the addition of two lifts to the one-time three-lift spiral holder, increasing its capacity to 840,000 c.ft. Thus, with the 530,000 c.ft. of the four-lift holder, the total storage now amounts to 1,370,000 c.ft.

INTERESTING STATISTICS (YEAR ENDED DEC. 31, 1923).

Capital raised—				
Consolidated stock	£129,140	0	0	
Debenture stock	11,000	0	0	£148,076 3 5
Premiums	7,935	3	5	
Number of stockholders				287
Coal carbonized				30,579 tons
Average cost of coal				35s. 3d. per ton
Gas made				444,000,000 c.ft.
Coke made for sale				12,617 tons.
Tar made				440,603 gallons
Sulphate of ammonia made				260 tons
Number of consumers—Ordinary				3352
Automatic				5252 } 8604
Turnover				£129,564
Appliances on hire—Cooking				5871
Heating				1726
Area of district				6⅝ square miles
Miles of mains				43
Public lamps				1346
Gas consumed by public lamps				25,094,300 c.ft.
Maximum outputs—				
Day's (summer)				1,665,000 c.ft.
Day's (winter)				1,515,000 c.ft.
Three hours, 11-2 (August, Sunday)				539,000 c.ft.
One hour, 12-1 (August, Sunday)				224,000 c.ft.
Number of staff and employees				190
Salaries and wages				£29,360.

THE MELTING-POINT OF COAL ASH.

Extracts from Recent Research.

From the Lancashire and Cheshire Coal Research Association we have received a copy of their Bulletin No. 15. This embodies the result of an investigation on the melting-point of coal ash, carried out by F. S. Sinnatt, M.B.E., M.Sc., F.I.C., M.I.Min.E., N. Simpkin, M.Sc., A.I.C., and A. B. Owles, A.I.C. The Bulletin is published by H. F. & G. Witherby, No. 326, High Holborn, W.C., at the price of 2s. net. The matter is divided into two sections, the first of which deals with a consideration of the importance of the subject, and reviews the method employed by previous workers; the second part being concerned with a description of the apparatus employed in the present research, and the results obtained. The authors point out that the preparation of coal for industry leads not only to an alteration in the proportions of the inorganic constituents by virtue of the partial elimination of certain components, but also to an alteration in the relative proportion of the Stopes ingredients present. Both of these have an influence on the melting-point of the ash of a particular grade of coal; and it is shown that various sections of a seam may yield ash the melting-point of which is widely different from that of the ash obtained from an average sample of the seam.

COMPOSITION OF COAL ASH—CORRELATION WITH MELTING-POINT.

The inorganic constituents of coal from which the ash is derived consist of the inherent inorganic matter of the coal (*i.e.*, vitrain, clarain, durain, and fusain), extraneous inorganic matter (ankerites, pyrites, and shales), and material introduced into the seam during the winning of the coal. When the coal is incinerated, the ashes from these sources may be recognized as separate substances, and their behaviour as a whole in respect of fusibility depends on the size of the particles and the degree to which they are associated. Though certain generalizations appear to be permissible—*e.g.*, that ash containing a high proportion of silica and alumina possesses a relatively high melting-point—it is not possible to state what influence variations in the proportions of the constituents will have on the melting-point. Mention is made in the Bulletin of the attempts made to establish a definite relationship between the melting-point and the percentages of chemical elements or radicals. The refractory quotient of Prost is cited, who suggested that the melting-point increased with the value of this quotient, which was obtained by applying the following formula:

$$Q = \frac{\text{O in } Al_2O_3}{\dfrac{\text{O in CaO} + \text{O in } Fe_2O_3 + \text{O in MgO}}{\text{O in } SiO_2}} \quad \text{O in } Al_2O_3$$

Though Palmenberg came to the conclusion that no relationship existed between the fusion-point of coal ash and the percentage of iron and sulphur present, Burgwin concludes that a relationship does exist; and the following is a brief table showing his results:

P.Ct. of Constituent in Ash.	Melting-Point (° C.).
Below 10 p.ct. of Fe_2O_3	Always above 1399°
Above 20 p.ct. of Fe_2O_3	Always below 1399°
Below 3 p.ct. of S + Fe_2O_3	Above 1399°
Above 3 p.ct. of S + Fe_2O_3	Below 1399°

The authors of the present research, however, definitely state that chemical analysis is of little value as a criterion of the melting-point of an ash.

EXPERIMENTAL DETAILS.

The method employed by the authors consists in pressing the ash into a thin rod. By this means it is possible to carry out the determination with 0·2 gramme of ash. The coal is pulverized to pass a 60-mesh sieve, and is incinerated at 800 to 850° C. in a silica muffle in the complete absence of the products of combustion of coal gas. The resulting ash is pulverized to pass a 200-mesh sieve, is moistened with a small volume of a 10 p.ct. solution of dextrin, and worked into a viscous paste in an agate mortar. The paste is transferred to a press, which produces threads $\frac{1}{32}$ in. in diameter. The furnace is built up of magnesia brick completely covered with sheet steel. In this is placed a Vitreosil silica tube; and into this the ash is inserted on a piece of platinum foil. A platinum platinum-rhodium pyrometer is employed.

In view of the work of Stopes, the authors investigated the melting-points of clarain, vitrain, durain, and fusain, with the following results:

Melting-Points of the Ash of the Four Ingredients, ° C.

Seam.	Vitrain.	Clarain.	Durain.	Fusain.
X	1340	1310	1430	1220
Y	..	1260	1430	1200
Z	1310	1320	above 1450	1200

It is suggested, however, that the evidence is not comprehensive enough to state that the individual ingredients possess characteristic melting-points.

WAVERLEY ASSOCIATION OF GAS MANAGERS.

ANNUAL MEETING IN EDINBURGH.

THE Annual General Meeting of the Association was held in the Restaurant of Messrs. Ferguson and Forrester, Ltd., on Thursday, June 5. Mr. A. M'DONALD, of Prestonpans, occupied the chair, and there was a representative attendance of members.

NEW MEMBERS.

The following gentlemen were proposed as new members: Messrs. James Campbell, Dunfermline; Edward Farquharson, Lower Largo; W. Duncan, Gorebridge; Edward J. M'Rae (Messrs. James Milne and Sons), Edinburgh; Alexander J. Povoh (Messrs. J. H. Robinson & Co.), Leith; Frank Wells, Duns; John W. Mabbley (Messrs. Blair, Campbell, and M'Lean), Glasgow; L. Hislop, Dundee; Kenneth Aird (Messrs. R. and A. Main), Falkirk; J. Jamieson, Grantown; and J. Williamson (Messrs. James M'Kelvie), Edinburgh.

SATISFACTORY FINANCE.

The PRESIDENT said he supposed the members would be prepared to take the accounts as read. A detailed statement of income and expenditure would be found on the agenda. The sum of £30 was on deposit in the bank, while the Treasurer (Mr. R. J. Philp) retained a balance of fully £10 in his hands.

The abstract was accepted, and a vote of thanks was passed to the Auditor (Mr. John O'Halloran).

SECRETARY'S REMUNERATION.

Mr. A. DOW (Galashiels) proposed that the honorarium paid to Mr. R. J. Philp, of North Berwick, as Secretary and Treasurer, should be increased from five to ten guineas.

Mr. DAVID VASS (Perth) and the PRESIDENT spoke in favour of the proposal.

Mr. PHILP, while thanking the members for their generosity, said he would have preferred it if they had voted him no honorarium at all. A payment of ten guineas a year seemed a lot for an Association like the Waverley; but since it was the unanimous wish of the members he would fall in with the proposal.

THE NEW PRESIDENT.

It was reported that the Council had taken into consideration the question of the appointment of President for the year 1924-25, and the choice had fallen on Mr. Robert Taylor, of Aberlady.

Mr. R. TAYLOR, briefly acknowledging the honour, said he would do his best to further the interests of the Association.

Mr. R. J. Philp was unanimously re-elected Secretary and Treasurer, while Messrs. Richmond (Penicuik) and Skea (Jedburgh) were appointed to fill two vacancies on the Committee.

Mr. ALEXANDER M'DONALD then delivered the following

PRESIDENTIAL ADDRESS.

I thank you for the honour you have done me in asking me to occupy the presidential chair at your meeting to-day. I feel highly honoured to occupy such an exalted position in this the oldest Gas Association in the world, and I hope that my humble effort at an address will meet with your approval, and perhaps throw some light on the subject dealt with—viz., the complete gasification of coal.

COMPLETE GASIFICATION OF COAL.

In venturing on such a debatable subject, I realize that I am opposed to many firm opinions in favour of high-grade gas. But I hold that there is no standard quality of gas, and I base my contention on the following figures from the "Gas World Year Book." These figures show no standard quality in any country, and I presume the various qualities are all suitable.

Scotland . .	375 B.Th.U. at 5s. 10d.		550 B.Th.U. at 8s. 4d.	
England . .	320	,, ,, 6s. 9d.	618	,, ,, 7s. 1d.
Ireland . .	400	,, ,, 4s. 6d.	550	,, ,, 10s.
Australia . .	430	,, ,, 6s. 9d.	660	,, ,, 12s.

These are only a few examples taken at random; but I think they go to prove that any quality of gas is right, provided you have the apparatus to use it efficiently. After the war, Prestonpans, along with many other gas-works, was faced with the extension of carbonizing plant; and as prices were very high at the time (1919), the type of plant selected, and the cost, had to be carefully considered, so as not to saddle the undertakers with huge capital expenditure. Verticals, horizontals, water-gas plant, and the Tully plant were all considered. A new horizontal bench did not offer anything better than we were getting from our old bench; verticals were out of the question owing to the high cost; water gas could never be anything other than an auxiliary; while Tully gas offered something with possibilities. Though the plant has not done exactly what we were told it would do by the Tully firm and various gas managers, it has done very well indeed. My idea at first was to instal a 75,000 c.ft. per day plant, with provision for duplicating if it proved satisfactory; but we eventually decided to put down two generators, each capable of producing 100,000 c.ft. per day. These at first did not produce the guaranteed quantity, owing to the deep fuel bed—viz., 5 ft. 6 in.—and the consequent long period of the blow—viz., 3 min.; but since Messrs. Tully have altered and relined the generators, we have had no difficulty in producing the guaranteed quantity per day; the blowing period now being only 1½ minutes, thus allowing for a longer gas-making period.

DESCRIPTION OF THE PLANT.

I will only give you a short description of the plant, as I have no doubt most gas managers are fully conversant with the system. The plant consists of a brick-built retort, measuring 8 ft. 9 in. long and tapering from 1 ft. 6 in. at the top to 2 ft. at the bottom, surrounded by chequer brickwork, with secondary air and combustion chambers at the bottom, and a collecting chamber at the top. The generator is directly underneath and in communication with the retort, the depth being 3 ft. 6 in. from combustion nostrils to firebars. The whole is contained in a steel shell measuring 16 ft. by 6 ft. diameter. Primary and secondary air are admitted during the blow, the primary under the firebars and the secondary in line with the combustion chambers, the resulting combustion heating the chequer work and retort, and partially carbonizing the coal. Primary and secondary air and snift valves are all operated by one lever. After blowing for 1½ minutes, the air and snift valves are shut. Steam is then admitted, and the resulting water gas and low-temperature gas from the retort are passed on to the purifying plant, the operation of opening gas-valves and steam valves being done with one lever. The retort is charged with about 5 cwt. of coal every two hours, the make being about 30,000 c.ft. per ton, at a cost of about 8d. per 1000 c.ft. for coal, and 5d. for wages.

Complete gasification is no new thing. Many gas engineers have been after it for years, and direct-fired horizontal settings, verticals, and water-gas plants have all been aiming at taking more and more gas from the coal. Even in the direct-fired setting you have more often than not compete gasification, by first putting your coal in the retort, allowing it to remain there for three or four hours, then withdrawing the coke and completing the gasification in the furnace—a most wasteful and laborious method of achieving the object, compared with the simpler method of the plant described, where the coal is fed in at the top and is almost completely gasified in its course through retort and producer.

When I first proposed supplying Tully gas alone, I was told by many people that it would not do—the sale would increase, consumers' bills would be higher, mains would require to be enlarged, pressures would have to be increased, and there were many other things it would and would not do—but so far I have not found this prophecy correct. Our make has not increased any more than normal, as shown by the following figures:

	C.Ft.		C.Ft.
1915 . .	8,957,700	1920 . .	14,435,600
1916 . .	8,835,000	1921 . .	16,073,700
1917 . .	10,406,000	1922 . .	17,681,500
1918 . .	11,665,000	1923 . .	19,348,600
1919 . .	14,039,600	1924 . .	21,300,000

From these figures it can be seen clearly that the introduction of low-grade gas has not brought any large increase in the sale. Nor have the consumers' accounts shown any large increase. I submit the following figures for your information. First, four manufacturers' concerns:

	1919. C.Ft.		1923. C.Ft.
1	266,800	..	212,000
2	179,100	..	86,300
3	118,500	..	54,200
4	65,400	..	41,300
Second, a group of three professional men:	49,200	..	42,300
Then a group of five miners:	96,300	..	88,100

GAS CONSUMPTION.

These figures are taken at random from my survey books, and show what the gas can do; and though all my customers' accounts are not smaller than they were, I am convinced that, provided the proper burners, &c., are used, little or no difference will be felt by the consumer. The mains have not had to be enlarged; and a mantle can easily be filled with less than 2 in. pressure. The gas is giving entire satisfaction to the consumers, and, I think, giving them every bit as good service and value as they ever had with high-grade gas.

The gas consumed by the various burners at 2-in. pressure is as under:

No. 1	1·8 c.ft. per hour.
No. 2	3·3 ,, ,,
No. 3	4·2 ,, ,,

On a water-boiling test in an ordinary enamelled domestic pot, the figures obtained were as follows:

Water.	Temp.	Time to Boil.	Gas Used.	Rate per Hou.
1 quart ..	54° Fahr. ..	13 min. ..	2·11 c.ft. ..	10 c.ft

The gas is regular in quality; and when I tell you that half my consumers are supplied from the inlet of the holder, you can realize how steady the quality must be.

The gas is made entirely from Preston Links jewel coal. There is no skilled labour required to work the plant; a strong lad could work two generators and make anything from 10,000 c.ft. per hour upwards. The generators are operated on a 1½-min. blow and 5½-min gas-making period, charged every two hours, cleaned every four hours, and clinkered every twenty-four hours. At present we are making all our gas between 6 a.m. and 5 p.m., and close the gate every night at five o'clock until six o'clock the next morning, including Saturdays. The actual carbonizing costs for April were: Coal, 9·0d. per 1000 c.ft.; wages, 3·1d.—a total of 12·1d. per 1000 c.ft. This figure is for gas making only, and does not include any yard work.

I am at present faced with competition from electricity, and have in open competition with the electricity company secured the lighting of the Prestonpans street lamps. In connection with this, our Lighting Committee paid a visit to the local electricity station to see what they had to offer; and after seeing the lights in some other towns in the country, they told me we were as good, if not better, than any of them. I might also quote the opinion of an English gas engineer who visited my district to investigate the claims of this gas. He stated at a meeting of managers that he had just come from a district supplying this gas. He had seen it in an ordinary dwelling house in use for fires, cookers, and lights; he had seen it on the streets, and in a public building, and as far as he could judge it was doing all that any gas could do. After leaving the district he passed through two other districts where the gas was known to be of a much higher quality, and as far as the eye could judge the lamps in the "low-grade" town were as good as, if not better than, those in the "high-grade" towns.

In conclusion I would give you the following figures for December, 1918, and December, 1923. These figures cover the cost of boiler fuel and household coal—1918 all coal gas and 1923 all Tully gas.

1918 Coal Gas.	Per 1000 C.Ft.	1923 Tully Gas.	Per 1000 C.Ft.
Coal, at 27s. per ton . .	= 28·3	Coal, at 25s. 6d. per ton .	= 11·6
Wages, at 57s. per week .	= 5·4	Wages, at 60s. per week .	= 3·6
	33·7		15·2
Less residuals . . .	7·1		0·5
Total cost per 1000 c.ft.	26·6d		14·7d.

I think that, in the face of the figures given (which have all been carefully gone into), you will agree that Tully gas is not at all a bad proposition, even with the high prices for coke at present ruling. I have no doubt that at some future date, when coke becomes a burden on gas-works, water gas and Tully gas will come into their own again. Meantime the thanks of the industry are due to those who are gasifying their coke and thus making a better market for those who have coke to sell.

Discussion.

Mr. W. BROWN (Burntisland), opening the discussion, remarked that there were one or two points in the address which ought to be investigated. The President did not tell the members the calorific value of the gas, nor did he give any information as to the price he was selling at. He (the speaker) was desirous of presenting some figures in regard to actual tests made on the Tully plant at Burntisland. These were carried out between Dec. 18 and 20, 1923, and the figures were certified by the chemist. His report proceeded on the following lines:

> The final adjustments of the air valves resulted in an analysis of blast gases thus:
>
> | | P.Ct. |
> |---|---|
> | CO_2 | 16·2 |
> | O_2 | 0·9 |
> | N_2 | 0·4 |
>
> Appended are comparative samples of up and down runs:
>
> | | Up-Run. P.Ct. | | Down-Run. P.Ct. |
> |---|---|---|---|
> | CO_2 | 6·2 | .. | 5·4 |
> | O_2 | 0·2 | .. | 0·0 |
> | C_nH_m | 1·0 | .. | 0·2 |
> | CO | 34·4 | .. | 31·6 |
> | H_2 | 50·75 | .. | 54·35 |
> | CH_4 | 4·14 | .. | 2·93 |
> | N_2 | 2·31 | .. | 3·92 |
> | | 100·00 | | 100·00 |
>
> The estimated calorific value of the up-run gas was 345 B.Th.U., and the estimated calorific value of the down-run gas was 315 B.Th.U. Over hourly tests the average amount of gas made was 5500 c.ft. The estimated make per ton over a whole day's working was 58,100 c.ft. Taking the average calorific value as 330 B.Th.U., the plant yielded 191 therms. The plant is working with all coal and with a cycle of six minutes run, three minutes blow, two up to one down, and with a steam pressure of 30 lbs.

These figures were authenticated by the chemist, and he thought the data provided in regard to the tests at Burntisland would be found of value to the members. In regard to pressure, he disagreed with the President. There must of necessity be a higher pressure. He could not subscribe to the claim made by Mr. M'Donald that, while his make had increased from 8 to 21 millions, the pressure had not been substantially increased. The figures as between 1919 and 1924 indicated that there must have been abnormal circumstances. His experience at Burntisland showed that, with practically the same number of consumers, the make of gas had increased from 28 millions in 1917 to 42 millions. On the other hand, the consumers' accounts had risen accordingly. He was asked by his Gas Committee to go carefully into the accounts over a period of three years—two years before the introduction of the Tully plant and one year with that plant in operation. The comparison was of peculiar interest to him. Probably 5 p.ct. showed an appreciable increase, 75 p.ct. were about the same, while the other 10 p.ct. or so were lower. If all the circumstances were taken into consideration, the situation could be easily explained. If they were not careful in handling the Tully plant, they invariably got a large amount of inerts in the gas. In his case at Burntisland, the calorific value was 325 B.Th.U.—if it ever reached that—and the point he was desirous of emphasizing was that gas of a calorific value of 300-325 B.Th.U. could possibly do more work at less cost than gas of a calorific value of 550 B.Th.U.

The PRESIDENT replied that, from calculations they had made, they reckoned the calorific value of the gas they were supplying was round about 375 B.Th.U. It had to be kept in mind that the generators at Prestonpans were entirely different from those at Burntisland, where the gas did not pass over the chequer work at all. The price in Prestonpans was 5s. 10d.

Mr. DAVID VASS (Perth) remarked that it seemed to him the case quoted by Mr. Brown was different from that of Mr. M'Donald. He thought he was right in assuming that the increase in output had been caused by the fact that the gas-works at Prestonpans was catering for a developing district. New supplies had been introduced into the colliery houses. The actual number of consumers had been increasing since 1919, when, with the war at an end, the gas industry was able to march forward.

The PRESIDENT: You have correctly stated the position, Mr. Vass.

Mr. VASS asked if the figures which were given in relation to costs included the fuel used under the boiler for raising steam.

The PRESIDENT indicated that the figures for 1923 included the cost of boiler fuel.

Mr. A. DOW (Galashiels) thought the address they had just had was a first-rate advertisement for the Tully plant, if they accepted everything as it appeared in print. The year 1919 was, they all knew, a boom year, whereas 1923 was one of depression. What he was anxious to know was whether the manufacturing concerns in 1923 had the same output as in 1919. Information on that point would enable him to appreciate the comparison that had been made. He believed the President would find it instructive if he used a calorimeter. The President had said: "The gas is regular in quality; and when I tell you that half my consumers are supplied from the inlet of the holder, you can realize how steady the quality must be." He (Mr. Dow) did not consider it made much difference whether the consumers were supplied from the inlet or outlet of the holder. He was a little surprised to observe that Mr. M'Donald claimed his residuals to be 7·1d. per 1000 c.ft. Certainly he would have expected them to be a little higher. He doubted whether the President was making gas equivalent to 375 B.Th.U. He was speaking frankly on this matter, because he had the feeling that the standard was being stretched. He did not consider there could be total gasification with the Tully plant, to secure a standard quality of 375 B.Th.U.

Mr. GEORGE BRAIDWOOD (Coatbridge) remarked that there were a few points in the address which appealed to him very much. If these were correctly stated, then the Tully plant was as likely as not to be a good thing in some respects. The President contended that there was no standard quality of gas. The Gas Regulation Act was brought into force so that people might take advantage of the residuals markets, and sell the quality of gas they declared. So long as they declared the value, everything was in order. There was one point in connection with Tully gas which had to be kept in view, and it arose in regard to what Mr. Brown had said about making gas of 330 B.Th.U. Under the provisions of the Gas Regulation Act, a special pressure certificate had to be obtained if it was proposed to supply gas under 350 B.Th.U. In the course of the address, the President made one very interesting observation—namely, that at Prestonpans they were making all their gas between 6 a.m. and 5 p.m. If this was likely to be the case in smaller works, then it seemed to him it was going to be a fine thing for the Tully plant. It would be a boon to those managers who were expected to work night and day. On the subject of public lighting, he thought it was well known that a mixture of water gas and coal gas gave a more brilliant mantle than did ordinary coal gas. Towards the close of his address Mr. M'Donald had hazarded the belief "that at some future date, when coke becomes a burden on gas-works, water gas and Tully gas will come into their own again." This surely was an argument in favour of the Gas Regulation Act.

Mr. GEORGE BRUCE (St. Andrews) thought the President was to be congratulated on the courageous manner in which he had presented his address. Personally, he felt that some of the criticisms had been severe. The President was in charge of a small works, and it was the general experience that on a small works it was often difficult to get all the statistical reports that might be asked for. Touching on the point that had been raised regarding the price of gas in Burntisland and that in Prestonpans, he considered that the two rates compared favourably with each other. The works at Burntisland were now in such a state, due to the development of the district, that Mr. Brown would require in a year or two to face a very heavy capital expenditure. The price of gas there would probably have to go up considerably. These were the circumstances that had to be considered, and which made it difficult to compare one gas-works with another.

Mr. H. GRACIE (Edinburgh) said that in the question of cost of gas they could not compare a small works with a larger one. He was in agreement with Mr. Braidwood—that the adoption of the therm method of charging had been the right thing for the consumer. In the past there had been too much of a rush on the part of gas managers to maintain big makes per ton. The best and safest plan was always to try to give the consumers the most satisfactory results for the time being.

Mr. G. BRUCE remarked that, on the general question, he was not going to agree that with a low-grade gas they would get the same efficiency as with a high-grade gas. It would be a good thing if gas managers would face the fact that, if they wanted to be free from complaints from consumers, they should supply a standard of gas that would satisfy the district. A standard of from 460 to 475 B.Th.U.

was, to his mind, very satisfactory. Also there could be no denying the fact that with low-grade gas the cost of repairing meters went up considerably. During the first quarter when they were manufacturing low-grade gas, the meter bill went up by from 25 to 50 p.ct. Mr. M'Donald, in the working of the Tully plant at Prestonpans, had done exceptionally well, and was to be congratulated rather than criticized.

Mr. GRACIE reminded the President that a year ago he carried out an analysis for Prestonpans. It might satisfy the meeting if Mr. M'Donald was in a position to produce the figures. In any case, he would be glad to make another analysis if the President considered it advisable.

The PRESIDENT said that since the analysis was taken the plant had been altered considerably. In the circumstances, he would be glad to avail himself of the offer made by Mr. Gracie.

Mr. Dow did not want the suggestion to go out that some of his critics were attempting to browbeat the President. This was not the idea. Speaking for himself, he had been most anxious to get the fullest information possible, and it was because of this anxiety that he had directed so many pertinent questions to Mr. M'Donald. He was merely anxious to test the claim put forward for the plant at Prestonpans. If the President had given the candle-power, this would have thrown a great deal more light on the subject.

Mr. BRUCE said he had no intention of implying that any member was desirous of browbeating the President. He had been prompted to speak as he had done because he had the feeling that some of the criticisms were being put forward in a cynical sort of way.

Mr. BROWN declared that any criticism he had levelled against Mr. M'Donald had been in a friendly spirit, and with the best of intentions. He was merely anxious to get the fullest information he could for the benefit of the members.

The PRESIDENT, in the course of his reply, justified all his figures and arguments. On the question of inerts, he maintained that these were low, and that care was taken to look after the valves. These were cleaned every week, and kept absolutely tight. In fact, no air was allowed to pass with the gas. In regard to price, the figures he had given were only carbonizing costs. There were many other costs to be read into the calculation. During the course of the present year, they had added about 300 new consumers. He was well aware that he might have been better off had he left a lot of figures out of his paper, but he wanted to give the members the fullest information possible about Tully gas.

Mr. DOW: I note you say your meter was tested and found to be correct. Had you a test dial on the special meter you were using?

The PRESIDENT replied in the affirmative.

The discussion was at this point brought to a close.

SUBSEQUENT PROCEEDINGS.

Mr. M'Donald, as retiring President, was afterwards presented with the Association's medal, and briefly expressed his thanks.

Subsequently the members partook of luncheon, and later in the afternoon enjoyed a motor drive. Capital arrangements for the meeting, the luncheon, and the drive, were made by Mr. Philp.

ATMOSPHERIC POLLUTION.*

There has been published by H.M. Stationery Office, Imperial House, Kingsway, W.C. 2, the Ninth Report of the Committee for the Investigation of Atmospheric Pollution. The report covers the year ended March 31, 1923.

Among the members of the Committee during the year, appointed by the Meteorological Committee, were Sir Napier Shaw, F.R.S. (Chairman), Prof. H. B. Baker, F.R.S. (Royal College of Science), Prof. J. B. Cohen F.R.S. (University of Leeds), Mr. J. G. Clark (Gas Light and Coke Company), Dr. H. A. Des Vœux (Hon. Treasurer of the Coal Smoke Abatement Committee), Dr. J. S. Owens (Hon. Secretary), and Dr. T. L. Bailey (Chief Alkali Inspector). Dr. Margaret Fishenden (Westminster Technical Institute) was appointed by the Department of Scientific and Industrial Research. A number were also nominated by co-operating municipal authorities. Among those on the Technical Sub-Committee were Sir Napier Shaw, Mr. Clark, and Dr. Owens.

AN IDEA OF THE CONTENTS.

After a short introductory section and summary, the year's operations are described in six sections. The first deals with the results obtained by what is known as the standard deposit gauge, in which atmospheric impurity accumulates month by month with the rain. By this method the amount of impurity which falls upon a measured area in the course of a month is measured and analyzed into insoluble and soluble impurity, tar and other carbonaceous matter, and ordinary wind-borne dust. Thirty-five such gauges were in use during the year. It is shown that there is a distinct improvement in the purity of the air during the year as compared with the average of preceding years. An interesting table is given showing the places with the highest and lowest deposits. The highest total deposit is shown in Rochdale, and the lowest in Rothamstead. The greatest amount of tar was deposited in Newcastle-on-Tyne, while the highest deposit of sulphates was found in Southwark Park, London. The second section deals with a new form of stoneware gauge introduced by the Committee as an improvement on the original type, which has now been tried for more than five years. No difficulty is found in analyzing the deposit, though the quantities are smaller than those obtained with the original large standard. In the third section the results obtained by the automatic filter are discussed. This instrument isolates near the edge of a circular disc of filter paper a succession of samples of the impurity extracted from the air, two to four every hour, and thus provides the means of examining the changes in the condition of the atmosphere as regards pollution from hour to hour, throughout the year. The measure is in this sense distinct from that of the impurity which collects in an open gauge. The curves of the suspended impurity derived from the instrument show in all places a maximum in the forenoon. The distribution over the 24 hours is very suggestive; and there is a curious tendency in London towards a reduction in suspended impurity towards the end of each week.

The fourth section deals with an instrument called the jet dust-counter. By its means the dust in a very limited quantity of air —50 c.c., for example—can be thrown upon a microscope cover-glass as a narrow streak of dirt, and can be examined under the microscope, the number of particles counted, and their shape and nature examined. The use of the instrument has extended rapidly both in England and in foreign countries. Its high efficiency and convenience of operation make it of great value in the examination of all problems connected with air-borne dust. Some interesting results have been obtained, as, for example, the discovery of spherical glassy particles in the air, the sudden appearance of large numbers of mould cells during the autumn, and the occasional presence of crystals of soluble salts. Many records have been taken in London during smoke fogs, from which it is seen that the number of particles in a smoke fog varies from 20,000 to something over 50,000 per c.c. It is of interest to learn that, during a heavy smoke fog in London, a man would breathe in the course of 24 hours 500,000 million particles of suspended matter. Their size is such that, if placed in contact, these would form a string about 250 miles in length. This way of looking at the degree of pollution of the air gives some idea of the work which must be done by the cilia and cells of the respiratory organs to remove the impurities breathed in.

The fifth section is devoted to a description of researches on the visibility of distant objects as affected by atmospheric pollution. The methods developed and the results obtained are described. The effect of suspended matter in this connection may be considered under two heads—the effects on visibility, and other effects of diminishing transparency. The first is of special interest meteorologically, and is of greatest importance in connection with transport by sea, land, or air. The latter is important in its bearing on human health, growth of vegetation, and the problem of artificial lighting during winter months. Work was undertaken to arrive at a correlation of the total amount, and as far as possible of the nature, of suspended matter in the air, with the obstruction it offers to the passage of light through a column of the air of known length. This is not synonymous with the term visibility, though the two are intimately connected. In the absence of scattered light, visibility of any suitably illuminated object would no doubt be governed by the obstructive power of the atmosphere, which is independent of extraneous light; but when the suspended matter is diffusely illuminated by (say) daylight, it acts as a veil which reduces considerably the visibility of objects viewed through it—an effect superimposed upon that due to obstruction.

FURTHER POINTS UNDER INVESTIGATION.

Observations are being made in the United States of America and in Belgium on the distribution of impurity in the vertical by means of dust-counter records taken from aeroplanes, and arrangements are being made for similar observations in England. The report states that a very important point calling for investigation is the distance travelled by impurities from their source, and the distribution over the country. Individual observations taken at intervals since the method of counting dust was evolved show that impurities travel great distances; and it appears certain, for example, that the haze met with over the South of England is produced in the manufacturing cities of the Midlands, or even farther north. It is hoped to take a series of records in such a haze while travelling up-wind, with a view to tracing the impurity to its origin. Other points calling for investigation are: The relation of impurity to strength of wind; the relation of bacterial contents to smoke; and the effect of temperature lapse rate to distribution of impurity in the vertical.

In the sixth section we are told that research in the field of atmospheric pollution covers problems of great importance from the points of view of health, economy, preservation of buildings, visibility, formation and prevention of fogs, and other matters having a bearing on the public weal. An attempt was made to correlate the amount of suspended impurity with the number of deaths occurring in London. No very definite relationship could be observed, though the relation between death rate and minimum temperature appeared to be fairly constant.

* Meteorological Office, Air Ministry. Report of the Advisory Committee on Atmospheric Pollution for the year ended March 31, 1923. Price, 4s. 6d. net.

Glover-West Retorts at Le Mans.—In our article in the "JOURNAL" of May 28, p. 624, we omitted to mention that this installation was by La Cie. Gle. de Construction de Fours, of Montrouge (Seine), who have the rights of construction of the Glover-West system in France and some other countries on the Continent.

GASEOUS COMBUSTION AT HIGH PRESSURES.

PART IV.—THE INFLUENCE OF VARYING INITIAL PRESSURES UPON THE RATE OF PRESSURE DEVELOPMENT AND THE ACTIVATION OF NITROGEN IN CARBON-MONOXIDE-AIR EXPLOSIONS.

By WILLIAM A. BONE, D.Sc., Ph.D., F.R.S., D. M. NEWITT, B.Sc., D.I.C., and D. T. A. TOWNEND, B.Sc., D.I.C. (Salters Research Fellow).

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(*Concluded from p.* 750.)

EXPERIMENTS WITH VARIOUS $2CO + O_2 + 4R$ MIXTURES (WHERE R = DILUENT) AT AN INITIAL PRESSURE OF 75 ATMOSPHERES.

In view of the intensity of the nitrogen-activation observed when a normal CO-air mixture was exploded at an initial pressure of 75 atmospheres (*vide* the preceding section), it was decided to make a further comparative series of experiments at the said initial pressure, but employing mixtures in which the nitrogen of the normal CO-air mixture was progressively replaced by equivalent volumes of other diluents (O_2, CO, or A*r*).

The results of these experiments, which are summarized in Table VII., generally support the previous conclusion that at such high pressures the primary N_2-activation is immediately followed by a considerable secondary NO-formation, except where the original mixtures contain a fairly large excess of carbon monoxide—*e.g.*, in the case of $2CO + O_2 + 2CO + 2N_2$ mixtures.

TABLE VII.—*Experimental Results with Various* $2CO + O_2 + 4R$ *Mixtures at an Initial Pressure of 75 Atmospheres.*

Experiment No.	$2CO + O_2$ Knall-Gas Diluted with	T_i. Abs.	t_m.	P_m.		P_m/P_i.	P. Fall in 1 Sec. After t_m.		T_m. Abs.
				Obs.	Corrd.		Atmos.	P.Ct.	
46	$+ 4N_2$	289°	0·30	635	682	8·5	131	20	2865°
49	$+ O_2 + 3N_2$	289°	0·10	658	672	8·8	155	23·5	2965°
50	$+ 2O_2 + 2N_2$	288°	0·03	675	680	9·0	165	25·0	3020°
47	$+ 4O_2$	283°	0·005	760	760	10·1	257	33·8	3345°
51	$+ CO + 3N_2$	289°	0·135	680	700	9·1	161	23·7	3070°
52	$+ 2CO + 2N_2$	289°	0·100	701	720	9·4	179	25·5	3170°
53	$+ 4CO$	287°	0·015	720	727	9·6	223	30·9	3215°
54	$+ Ar + 3N_2$	278°	0·240	680	717	9·1	150	22·1	2950°
55	$+ 2Ar + 2N_2$	285°	0·130	725	744	9·7	163	23·0	3225°
39	$+ 4Ar$	284°	0·015	780	780	10·7	258	32·7	3545°

It will be observed that, in the last-named case, the pressure equivalent of the exothermic effect observed during the first second of the cooling period after t_m (32 atmospheres) exceeded by more than four times the amount (7 atmospheres) by which the "corrected" P_m value fell below that for the corresponding isothermic $2CO + O_2 + 4CO$ mixture, which again is a sure sign of a primary N_2 activation having occurred in the particular explosion referred to.

THE SECONDARY FORMATION OF NITRIC OXIDE IN OUR EXPERIMENTS.

Though reference was made in our previous paper to the fact that there was always a much greater oxidation of nitrogen in our CO-air than in our H_2-air explosions at initial pressures of 50 atmospheres, the point was not further elaborated. But its obvious theoretical interest, as well as its bearing upon the important problem of nitrogen fixation, impels us to make some further observations upon it.

The possibility of successfully effecting a large-scale fixation of nitrogen by its direct oxidation has already been sufficiently demonstrated in the well-known arc process and by explosion methods, and is occupying many minds. The difficulties connected therewith arise from the facts (*a*) that nitric oxide is an endothermic compound, the formation of whose gramme molecule from its elements involves an absorption of 21·6 K.C.U.'s, (*b*) that, although obtainable by the reversible reaction $N_2 + O_2 \rightleftarrows 2NO$, it is not rapidly so formed at temperatures below 2000° abs., and it readily decomposes at temperatures above 2500° abs., and (*c*) that the proportion of it in equilibrium with its elements between 2500° and 3000° abs., even in the most favourable circumstances, does not exceed between 2 and 3 p.ct. Thus, for example, according to Nernst and his co-workers,* the thermal equilibrium for the NO-air system at various temperatures is as follows:

T. Abs	Percentages of		
	N_2.	O_2.	NO.
1877°	78·89	20·69	0·42
2023°	..	..	0·52 to 0·80
2580°	78·08	19·88	2·05
2675°	77·98	19·78	2·23

* "Zeit. Anorg. Chem.," Vol. 45, p. 116 (1905); Vol. 49, pp. 212, 229 (1906)

Moreover, the same authorities have estimated that the following times are required for the formation or decomposition of half the equilibrium proportion of nitric oxide at various temperatures.

T. Abs.	Half-Formation.	Half-Decomposition.
1900°	2·08 minutes	16,000 minutes.
2100°	5·06 seconds	1400 seconds.
2500°	0·01 seconds	5·6 seconds.
2900°	0·0000345 seconds	0·005 seconds.

If such estimates can be accepted as approximately reliable, it would seem (*a*) that in a gas-air explosion not much NO-formation can be expected unless the temperature attained exceeds 2500° abs., and (*b*) that but little of it would survive unless the subsequent cooling down to well below such temperature is exceedingly rapid. Now, we are informed that the maximum concentration of nitric oxide in the gases from the technical electric arc process does not usually exceed 1·5 p.ct., which is much below the calculated equilibrium proportion for the high temperature of the arc. Doubtless the decomposition of much of the NO actually formed in the arc is unavoidable, however rapidly the issuing gases may be cooled down. It should be mentioned that in 1907 F. Haber and A. Koenig obtained yields of nitric oxide in experiments with specially cooled high temperature arcs at temperatures below the melting point of platinum, using mixtures of nitrogen and oxygen at 100 m.m. pressure, which were far higher than those calculated from Nernst's thermodynamical equation; but they concluded that the formation of the nitric oxide in such circumstances was due to collision of electrons at comparatively low temperatures. Indeed, we believe it is now thought by many authorities that the formation of the nitric oxide in the electric arc is due primarily to the establishment of an electrical equilibrium upon which a thermal equilibrium is subsequently superposed.

It is long ago since Bunsen observed the formation of oxides of nitrogen in certain circumstances during gaseous explosions; and Hausser's recent efforts (*loc. cit.*) to establish a successful technical bomb-explosion process for the production of nitric oxide are well known. He now explodes mixtures of coke-oven gas (freed from sulphur) with excess of air (pre-heated to 300° C.) in 300-litre bombs at an initial pressure of 5 atmospheres, with rapid cooling of the resulting products, which then (he finds) contain on an average between 0·6 and 0·7 p.ct. of nitric oxide.

While it is impossible to make a direct determination of the amount of nitric oxide present in the products of a gaseous explosion at the moment of maximum pressure, the amount which survives in the products after they have been cooled down to the room temperature can be estimated without difficulty. And, as already indicated, the thermal decomposition $2NO = N_2 + O_2$ would be exceedingly rapid during the earlier part of the cooling period—*i.e.*, down to 2500° abs. Also, the presence of any excess of combustible gas would be inimical to the survival of nitric oxide; on the other hand, the presence of excess oxygen would both help to preserve it and ensure its conversion into NO_2 at temperatures below about 900° abs.

In order, however, to gain some further general information concerning the influence of such factors as initial pressure, excess oxygen, &c., upon the secondary NO-formation in such explosions as these we are investigating, we have carried out a number of experiments in which the comparative amounts of NO and/or NO_2 surviving in the cooled products of various N_2 — containing explosive mixtures, when fired in our bomb apparatus, have been determined. The principal results of these will now be briefly described.

A. *Influence of Excess Oxygen upon NO-Formation.*—We first of all exploded, at an initial pressure of 75 atmospheres, a series of isothermic mixtures in which the $2CO + O_2$ "knall-gas" was diluted with varying proportions of nitrogen and oxygen, in such wise that, beginning with a normal CO-air mixture ($2CO + O_2 + 4N_2$), half of its nitrogen was progressively replaced by its equivalent of oxygen—*i.e.*, until the nitrogen and excess oxygen present were in equimolecular proportions, which presumably would be the most favourable circumstances for the secondary NO-formation in the explosion. After the products had cooled down to the room temperature at the end of each experiment, the total NO and/or NO_2 remaining in the system was determined by the phenol-sulphonic acid method. The results were finally expressed in terms of the volume-percentage of nitric oxide in the gaseous products at atmospheric pressure, in Table VIII.

It will be seen that until there was a considerable excess of oxygen present in the mixture exploded, the amount of NO/NO_2

which survived in the cooled products was relatively small. In the case of $2CO+3O_2+2N_2$ mixture, however, where it amounted to as much as 3 p.ct. on opening the valve of the bomb after the explosion, so that the gaseous products were released, a strong smell of NO_2 pervaded the laboratory.

TABLE VIII.—*Experiments at an Initial Pressure of 75 Atmospheres.*

Experiment No.	Mixture Exploded.	t_m. Secs.	T_m. Abs.	Time Required for Cooling Down from T_m. to 2500° Abs.	P.Ct. of NO in Cooled Products.
56 . .	$2CO + O_2 + 4N_2$	0·30	2830°	About 0·5 to 0·6 sec.	0·03
57 . .	$2CO + 1\frac{1}{2}O_2 + 3\frac{1}{2}N_2$	..	..		0·05
58 . .	$2CO + 2O_2 + 3N_2$	0·09	2950°		1·00
59 . .	$2CO + 3O_2 + 2N_2$	0·03	3025°		3·00

It should be noted that the maximum temperatures reached in the several explosions were all high enough to allow of the attainment, within the time interval t_m, of the supposed thermal equilibrium proportion of nitric oxide, but that the 0·6 sec. occupied by the cooling down from T_m to 2500° abs. would probably be long enough to permit of the decomposition of a considerable part of any NO formed during the explosion. In the circumstances, the survival of as much as 3 p.ct. of NO in experiment No. 59 is perhaps remarkable, while the experiments as a whole constitute satisfactory evidence of the secondary NO-formation being largely dependent upon the presence of excess oxygen in the mixture exploded.

B. *The secondary NO-formation is not merely a thermal effect.*—The amount of NO_2 surviving in the cooled products when a mixture containing $2H_2 + 3O_2 + 2N_2$ was exploded in the bomb at an initial pressure of 75 atmospheres (Experiment No. 60) was next determined. The maximum temperature reached (in about 0·005 sec.) in the explosion would be about 2820° abs., while the time taken for the products to cool down from it to 2500° abs. was only 0·12 sec. as compared with 0·6 sec. in the corresponding $2CO + 3O_2 + 2N_2$ experiment (No. 59). The amount of NO_2 finally found in the products (including all the liquid obtained when the bomb was thoroughly washed out with distilled water at the end of the experiment) did not exceed 0·07 p.ct., or only one-thirtieth of that which survived in the corresponding experiment with carbon monoxide. We regard such a result as further supporting our view that any secondary NO-formation in our $CO - O_2 - N_2$ explosions is not merely a thermal effect but really depends upon a prior N_2-activation.

C.—*Influence of Initial Pressure.*—In a final series of experiments, we compared the percentage of NO_2 surviving in the cooled products when a mixture containing $2CO + 3O_2 + 2N_2$ (*i.e.*, the most favourable proportions of excess O_2 and N_2) was successively exploded in the bomb at initial pressures of 3, 25, 50, and 75 atmospheres, with the following results (Table IX.), which can hardly mean other than that the formation of nitric oxide in the explosion of mixtures containing CO, N_2, and excess of O_2 depends in a higher degree upon some factor which is controlled by the initial pressures.

TABLE IX.—*Experiments with Mixture $2CO + 3O_2 + 2N_2$ at Varying Initial Pressures.*

Experiment No.	P_i Atm.	t_m Secs.	T_m Abs.	Time Required to Cool Down from T_m to 2500° (abs.) Sec.	Percentage NO in Cooled Gaseous Products.
60 . . .	3	0·065	2500°	..	0·3
61 . . .	25	0·060	2680°	0·20	0·8
62 . . .	50	0·035	2880°	0·35	1·8
59 . . .	75	0·030	3020°	0·60	3·0

Reviewing as a whole the evidence as derived from this part of our work, we are led to conclude (i) that the formation of NO in such explosions is in the main primarily due to the combustion of carbon monoxide under pressure in the presence of nitrogen, and not to any purely thermal cause, (ii) that it is promoted by some factor which is controlled by the initial pressure, and (iii) that its survival largely depends upon there being an excess of oxygen in the system.

SUMMARY AND CONCLUDING REMARKS.

The additional facts established by the experiments described herein may be summarized in the following numbered paragraphs:

(1) Whereas on exploding in our bomb normal hydrogen-air ($2H_2 + O_2 + 4N_2$) mixtures, or a $2CO + O_2$ "knall-gas" (whether undiluted or diluted with excess oxygen or argon) an increase in the initial pressure shortens the time required to develop the maximum pressure, the reverse is the case with normal CO-air ($2CO + O_2 + 4N_2$) mixtures, where t_m progressively increases from 0·07 sec. when $Pi = 3$ atmospheres to as much as 0·45 sec. when it is 100 atmospheres.

(2) When $Pi = 3$ atmospheres, there is little or no difference as regards either tm, Pm, or the subsequent rate of cooling between the behaviour of a $2CO + O_2 + 4N_2$ mixture and that of the isothermic $2CO + O_2 + 4O_2$ mixture. In other words, at such initial pressures nitrogen acts in a CO-air explosion merely as a diatomic diluent, and exerts no other appreciable energy-absorbing function, which is only manifested at higher pressures.

(3) With $P_i = 10$ atmospheres, the peculiar energy-absorbing function of nitrogen in the explosion of a normal CO-air mixture is already apparent, and thereafter increases progressively with the initial pressure, until at initial pressures of 50 atmospheres and upwards it becomes a very marked feature of the phenomena associated with the explosion.

(4) When the function in question first becomes manifest, and over a considerable range of initial pressure thereafter (*e.g.*, 10 to nearly 25 atmospheres) it is marked by a large exothermic effect during the cooling period subsequent to the attainment of the maximum pressure, *without any appreciable lowering of the corrected P_m value.*

(5) Over a still higher range of initial pressure—namely, from 25 to 50 atmospheres, and probably somewhat beyond—the magnitude of the exothermic effect manifested during the first second of the cooling period subsequent to the attainment of the maximum pressure exceeds by about three times any lowering of the latter.

(6) Even at 50 atmospheres initial pressure, if the experimental conditions are rendered unfavourable to NO-formation by partial replacement of the nitrogen of a normal CO-air ($2CO + O_2 + 4N_2$) mixture by its equivalent of carbon monoxide, there is again always a considerable exothermic effect observable during the first second of the cooling period after the attainment of the maximum pressure on explosion, without any material diminution in the corrected P_m value.

(7) The corrected maximum pressure attained in the explosion of a normal CO-air mixture is slightly affected by secondary NO-formation at an initial pressure of 25 atmospheres, and more so at higher pressures, until at initial pressures of 75 and 100 atmospheres it is considerably so affected.

(8) Such secondary NO formation is favourably influenced by (*a*) higher initial pressure, and (*b*) the presence of excess of oxygen in the mixture exploded; and with regard to (*b*), when $P_i = 75$ atmospheres the optimum condition seemed to be reached when half the nitrogen of the normal CO-air mixtures ($2CO + O_2 + 4N_2$) was replaced by its equivalent of oxygen.

(9) So far as the instruments we have employed can show, nitrogen exerts no peculiar energy-absorbing function in the explosion of normal hydrogen-air mixtures at any initial pressure up to 75 atmospheres, which is the highest we have dared to employ in our present bomb in such cases. Moreover, not only was there no time lag in the development of maximum pressure in such explosions, but also the subsequent cooling curves were unaffected by any appreciable exothermic influence.

(10) Even when a $2H_2 + 3O_2 + 2N_2$ mixture is exploded at an initial pressure of 75 atmospheres, any NO-formation is incomparably smaller than in the case of the corresponding $2CO + 3O_2 + 2N_2$ mixtures in similar circumstances, although the condition as regards total energy development and relative concentration of combustible gas, excess oxygen, and nitrogen are precisely the same, and the difference between the maximum temperatures developed in the two explosions (about 2820° and 3020° abs.) is not great.

(11) Speaking generally, no appreciable "after burning" or other exothermic effect could be detected when such mixtures as $2H_2 + O_2 + 4N_2$, $2CO + O_2$, or $2CO + O_2 + 4Ar$ were exploded at initial pressures exceeding 10 atmospheres, and there was no sign of the maximum temperature in the explosion of an undiluted $2CO + O_2$ "knall-gas" at such initial pressure being limited by the dissociation of carbon dioxide, though the maximum temperatures attained in certain cases were as high as 5200° abs.

Such being the principal facts, we think they are best explained on our supposition of a *primary* N_2-activation by absorption of the peculiar radiation emitted by burning CO molecules, which may or may not be followed by a *secondary* NO-formation, according as the experimental conditions favour the latter or not. Such a view is capable of explaining all the facts brought to light up to the present during this research, and therefore holds the field. On the other hand, the alternative explanation of a *primary* NO-formation of a *purely thermal character* seems incapable of explaining the facts referred to in the foregoing paragraphs (4), (5), (6), (9), and (11), and therefore must be discarded.

As was pointed out in our previous paper, the supposition of a resonance-action between carbon monoxide and nitrogen in CO-air explosions accords with modern views as to the similar electronic constitutions of CO and N_2 molecules; and H. Nagoka* has recently published a paper in which attention is drawn to what he considers to be an approximate coincidence between the band spectra of the two gases, a matter which at least seems worthy of further investigation. We wish it to be understood that our present view is that the particular radiation emitted by burning carbon monoxide which is effective in activating the nitrogen in our experiments arises rather from direct interactions between CO molecules and : O atoms (or possibly O_3 molecules) than from interaction between CO and OH_2 molecules; because it can now be deduced from the results published in the Bone-Haward paper (Part II. hereof)† that the partial replacement of the CO by H_2 in a CO-air explosion at high initial pressures counteracts the N_2-activation, a circumstance which harmonizes with the views about the mechanism of CO-combustion advanced in that paper. We believe that further light upon this aspect of the matter may be gained from a spectroscopic investigation of the effect of gradually adding

* "Japanese Journal of Physics," Vol. 1, p. 49 (1922).

† "Proceedings of the Royal Society," A, Vol. 100, p. 67 (1921).

hydrogen to a carbon monoxide flame; and experiments with this end in view have already been started at the Imperial College by one of us in conjunction with Prof. A. Fowler and Mr. F. R. Weston (Gas Research Fellow).

Thanks to a further generous grant from the Government Grant Committee, which we hereby gratefully acknowledge, we have been enabled to order a new explosion bomb twice as strong as the present one, with which we contemplate carrying out further experiments on similar lines to those described in this paper but at still higher initial pressures. Also, we intend studying the effects of diluting a $2CO + O_2$ "knall-gas" with helium before explosion at high pressures, as well as completing the programme of work outlined at the end of our previous paper.

In conclusion, we also desire to thank the Department of Scientific and Industrial Research for maintenance grants, and the Salters' Institute of Industrial Chemistry for a Fellowship which has enabled two of us to devote the whole of our time to the investigation.

RECENT RESEARCH WORK AT THE MUNICIPAL COLLEGE OF TECHNOLOGY, MANCHESTER.

The amount and the value of the research work carried out at the Manchester College of Technology will be readily appreciated by those who have the good fortune to be in possession of a copy of their latest Journal, which is a record, in abstract form, of investigations undertaken by members of the College. The present volume is the eleventh of the series. Since 1916, when Volume 10 was published, war conditions prevented publication of the Journal. During this period, however, the output of research work from the College was not only fully maintained, but considerably increased. In Volume 11, therefore, the researches throughout this period are printed in abstract form, to maintain a continuous and useful record of the research work of the College. We learn from Mr. B. Mouat Jones, the Principal of the College, that it is now hoped to renew the publication of annual volumes.

The contents of Volume 11 are divided into five sections: Mechanical engineering, sanitary engineering, applied chemistry, textile industries, and mathematics. In the third section there is much of interest to readers of the "JOURNAL," as the following few extracts will indicate.

PRODUCTS ISOLATED FROM SOOT.

E. Knecht and E. Hibbert, in continuation of previous work on the subject, extracted with benzene a quantity of household soot collected in the Warrington district; and the extract (amounting to about 20 p.ct.) was examined. It represented a semi-solid pitchy mass which softened on heating, evolving a strong smell of soot. This extract yielded to petroleum spirit a yellow oily liquid which on treatment with a large volume of hot alcohol deposited a crystalline substance. On recrystallizing this from alcohol and methyl acetate, white crystals were obtained which showed a constant melting-point of 65° C. The substance was found to be identical with the hydrocarbon cerotene $C_{27}H_{54}$ isolated from hay by König and Kiesow. The benzene extract treated with glacial acetic acid went into solution to the extent of about 90 p.ct. This solution was diluted with water, when an oily substance separated. This was dissolved in ether, and freed from acid and phenolic constituents by means of dilute caustic soda. On evaporation, the ethereal solution left a dark-coloured semi-solid tar which, when distilled under reduced pressure, yielded a yellow oil which was found by analysis to have a composition corresponding to the formula $C_{15}H_{16}O$, and which was optically active. The portion of the benzene extract which dissolved in caustic soda was precipitated by sulphuric acid, filtered-off, redissolved in sodium carbonate, and again precipitated by acid, yielding a yellowish-brown substance which dissolved in alcohol and crystallized out on cooling. Several recrystallizations from this solvent yielded crystals having a light yellowish-brown colour and showing a constant melting-point of 135° C. The compound represents an organic acid having the composition $C_{10}H_{10}O_2$.

CHEMISTRY OF FUEL RESEARCH.

The research work in this direction was carried out by F. S. Sinnatt in collaboration with other investigators. A description is given of a modification of the apparatus first introduced by Kent-Smith and Towers for the rapid analysis of coal gas [see "JOURNAL," Vol. 148, pp. 250-54]. The sampling of coal is another subject dealt with; and reference is made to Bulletin 2 of the Lancashire and Cheshire Coal Research Association. The necessity for standard methods of sampling and analyzing coal is emphasized, and the principles underlying sampling, and the possible errors, receive special attention. In connection with the influence of inert matter on the volatiles evolved when coal is heated, it is mentioned that there is a slight increase in the percentage of volatile matter evolved the finer the state of division of the coal; while with an increase in the proportion of inert material present there is a distinct increase in the volatile matter evolved on heating. The influence of these factors on the stone dusting of mines and on the process of mixing coal and coke for steam-raising purposes is discussed.

A description is given of the work done on a deposit of solid paraffin wax (pentacontane, $C_{50}H_{102}$) found in Lancashire coal. A deposit of several tons weight of this material was found in the Arley Mine at a depth of 440 yards. It consisted of a dark-brown brittle, tasteless, and odourless wax. It was found to be free from sulphur, nitrogen, ash, or halogens, and soluble in hot toluene, benzene, carbon tetrachloride, aniline, and chloroform. The wax was not affected by strong alkalis or acids, with the exception of hot concentrated sulphuric acid. On purifying a hot benzene solution with animal charcoal, a white amorphous solid was obtained, having a melting-point of 93° C. and a solidifying-point of 92·7° C. Under 15 mm. pressure the wax boiled at 420° to 422° C., and about 85 p.ct. distilled without decomposition. The specific gravity was found to be 0·9422 when cold and 0·7940 at melting-point. It is the highest homologue of the paraffin series so far discovered occurring in nature.

Attention is drawn to an investigation into the composition of the unsaturated hydrocarbons present in coal gas. The bromine compounds of the unsaturated hydrocarbons of town gas were obtained by aspirating the gas through bromine. After purifying and drying, the liquid was distilled under a pressure of 15 mm. The distillate collected below 105° C. was fractionated, and ethylene, propylene, butylene, and amylene dibromides were obtained. The residue consisted chiefly of dibromobenzene. It was proved that the only compounds separated by this treatment were members of the ethylene series; and the percentage composition (by volume) was as follows: Ethylene 83·8, propylene 13·4, butylene 1·7, and amylene 1·0.

The various methods for the estimation of moisture, ash, volatile matter, and coke are described, together with the chief difficulties encountered and the precautions to be taken. The examination of the ash and the physical appearance of the coke button receive special attention. Mention is made of the agglutination curve. Another section deals with the fusain found associated with Lancashire coals, and the composition of dusts from mines in this area. Fusain is found in dusts produced naturally in much greater quantity than in the mass of coal. It possesses little cohesive power. The coal therefore fractures more readily along planes in which it occurs, exposing surfaces of coal covered with a layer of fusain, which quickly powders on exposure to the air. Dust from a dust collector attached to a belt picking room, and of which 95 p.ct. by weight would pass a sieve of 90 mesh, was found to contain about 49 p.ct. of fusain. Fusain ignites with ease, and continues to smoulder at a dull red heat without flame or odour, and may have a marked influence upon the tendency of a seam to produce gob fires. The percentage of this compound in Lancashire coals may be as high as 2·8 p.ct., while washing slurry may contain 25 p.ct.

The term "Hoo cannel" is used in Lancashire for cannel coals containing a high percentage of ash; and the Journal under review records the results of a study of the properties of a typical seam. The ash appears to be an inherent constituent of the cannel substance, since no removal can be effected by crushing or washing the material. The products obtained by carbonization are as follows:

—	920° C.	750° C.
Total gas made per ton	9870 c.ft.	7920 c.ft.
Corrected to N.T.P.	9820 ,,	7770 ,,
Corrected to 16 c.p. gas	9210 ,,	7920 ,,
Candle-power	15·0	16·3
Calorific value (B.Th.U. per c.ft.)	521	562
H_2S in crude gas, grains per 100 c.ft.	370	480
Coke per ton	1540 lbs.	1620 lbs.
	68·9 p.ct.	72·4 p.ct.
Tar per ton	8·0 gallons	11·5 gallons
	4·1 p.ct. by weight	5·8 p.ct. by weight

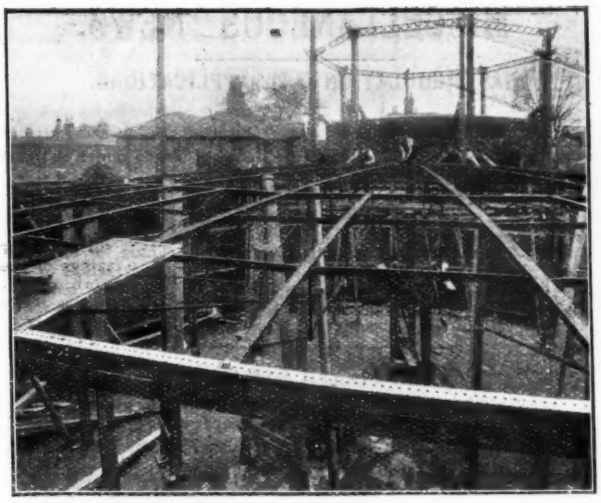
When it is mentioned that among the other subjects dealt with are the structure of coal seams, and the proportion and properties of the four constituents, the determination of the relative temperatures of spontaneous ignition of solid fuels, the chemical composition of iron pyrites from coal, and the preparation of coal for the market, the value of the work done at the Manchester College of Technology will be fully appreciated.

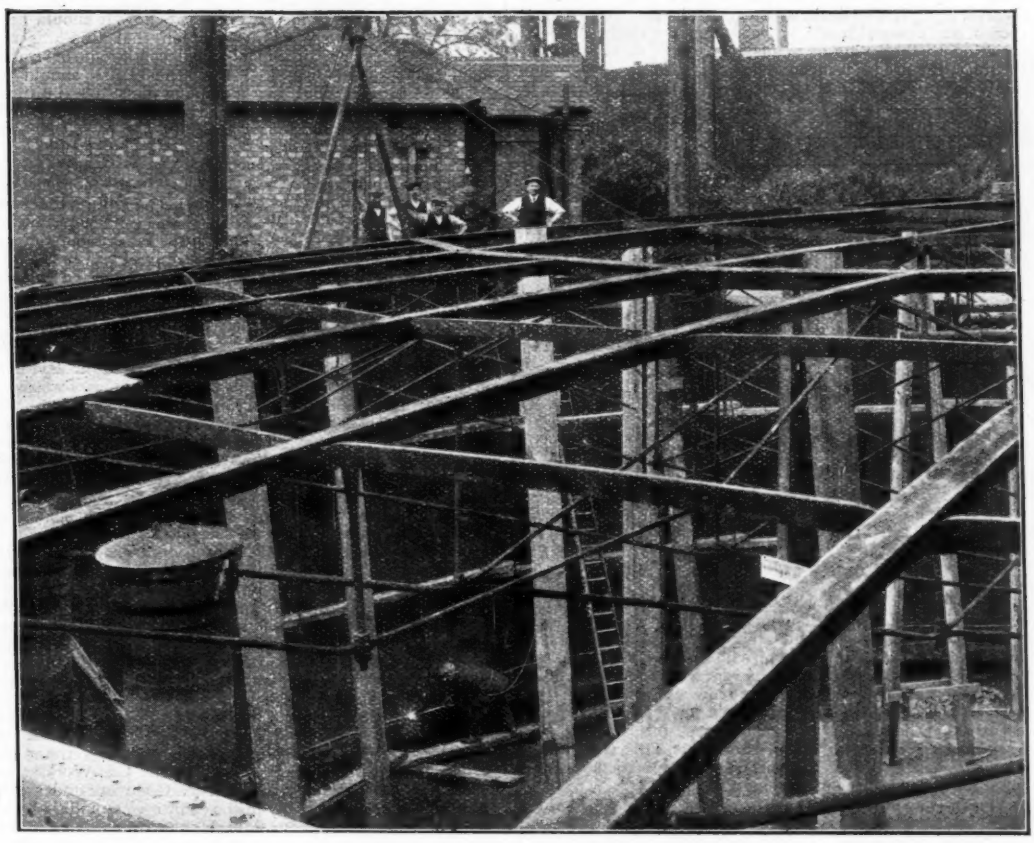
Oscillating Dehydration.

Mr. James H. Readio, Vice-President of the Tar Products Company, of Providence (R. I.), in an address delivered at the annual meeting of the New England Association of Gas Engineers, at Boston, told his audience that there is one method of tar dehydration which has come under his observation, and which to his knowledge has never been discussed. It might be characterized as "oscillating dehydration," and was first observed when tank cars of relatively dry tar were shipped over the rails for a considerable distance in warm weather. Such tars will invariably show a layer of supernatant water with a very dry tar underneath. "If," Mr. Readio went on, "an enterprising gas engineer would invent a machine to imitate the shuddering antics of a well-known type of automobile when the foot brake is suddenly applied, he would evolve a very efficient tar dehydration machine."

THE RE-SHEETING OF A GASHOLDER.

Our two photographs show a two-lift telescopic gasholder being stripped ready for re-sheeting. The cutting-away of the old sheets is being done by the oxy-acetylene process. The holder was originally built by Messrs. Penney and Porter, Ltd., of Lincoln (under the old title of J. T. B. Porter & Co.), about fifty years ago; and it is interesting to note that the whole of the framework is practically as good as new, and is being utilized again.





APPLICATIONS FOR PATENTS.

[Extracted from the "Official Journal" for June 12.]

Nos. 13,437 to 13,939.

BOCK, M.—"Indicators for automatic gas-analyzing apparatus." No. 13,909.

COOK, H. D.—"Pipe-joints, &c." No. 13,678.

EVERED, S., and EVERED & CO., LTD.—"Mechanism for controlling, lighting, &c., of gas-burners." No 13,823.

HELPS, G.—"Gas cookers and ovens." No. 13 843.

HUMPHREYS AND GLASGOW, LTD.—"Manufacture of gas." No. 13,616.

JACKSON, W. J. MELLERSH-.—"Eliminating hydrogen sulphide, &c., from fuel gases and air." No. 13,781.

KIRKE, P. ST. G.—"Internal-combustion engines." No. 13,756.

KOPPERS COMPANY.—See Jackson, W. J. Mellersh-. No. 13,781.

LADERER, H.—"Pipe joints." No. 13,908.

LUNDGREN, G. H.—See Cook, H. D. No. 13,678.

NICKLIN, M. E.—"Recovery of creosote oil from crude coal gas." No. 13,694.

PARKINSON AND W. & B. COWAN, LTD.—"Oil vaporizers and blow-lamps, &c." No. 13,906.

SMITH, E. W., and SMITH METERS, LTD.—"Coin-freed gas-meters." No. 13,515.

STELFOX, J. C.—See Humphreys and Glasgow, Ltd. No. 13,616.

Irish Gas Prices.—The price of gas in Newry has been reduced by a second 3d. per 1000 c.ft., bringing it to 5s. 10d., as compared with 9s. 6d. three years ago. It was stated at the Council meeting that a debt of between £6000 and £7000 had been wiped off, and that in a short time the undertaking would be able to contribute in relief of the rates. The Northern Ireland Ministry of Commerce have fixed the price of gas in Enniskillen to Sept. 30 at 9s. per 1000 c.ft., or 1s. less than last year. The price as from March to May was 8s., the maximum under the local Gas Act.

Bolton Gas Affairs.—To provide for increasing demands, and to modernize the gas undertaking, the Bolton Corporation have applied for sanction to borrow £21,525. Mr. A. W. Brightmore, an Inspector of the Ministry of Health, held an inquiry into the matter on June 4, when it was estimated that a considerable saving would be effected by the improvements. The Gas Engineer (Mr. W. J. Smith) said the Gas Committee were of the opinion that the Gas Street Works should be modernized, and extended to the capacity of 4,000,000 c.ft. per day, as early as possible. The work included the provision of a water-cooled condenser, and the construction of new underground tar and liquor wells. Complete with connections and foundations, the condenser was estimated to cost £3000, and the new tar and liquor wells £6400. The most expensive erection is that of meter shops. The present arrangements for collection, testing, repairing, and storing of meters and apparatus are spread over several sites, and the Committee have decided to erect new distribution workshops and stores at Spa Road, adjacent to the gasholder station. This will enable the whole distribution work to be carried out on one site.

MISCELLANEOUS NEWS.

GAS REGULATION ACT APPLICATIONS.

There has appeared in the "London Gazette" the following further notice regarding an application to the Board of Trade under the Gas Regulation Act.

SPECIAL ORDER.

Sheffield Gas Company.

The Company are applying to the Board of Trade for an Order under section 10 to enable them to acquire the undertakings of the Dronfield Gas Light and Coke Company and the Handsworth Woodhouse Gas Company, Ltd., to extend the limits of supply, to make provision as to prices to be charged, to regulate the supply of gas, &c.

THE PINNER GAS ORDER.

An application by the Pinner Gas Company, Ltd., for a Special Order under section 10 of the Gas Regulation Act, was inquired into by Mr. H. C. Honey (Director of Gas Administration at the Board of Trade) at the offices of the Board, on Thursday, May 29. The draft Order contains provisions for the issue of new capital and the authorization of additional borrowing powers, the erection of additional gas-works, &c. It also deals with dividends, and the reserve, special purposes, and renewal funds, and contains a number of usual provisions relating to the laying of mains, disconnecting of supplies, removal of fittings, the use of protective devices, supplies from mains of insufficient capacity, contracting for supply and purchase in bulk, &c.

There was opposition from the Middlesex County Council, the London Midland and Scottish and the London and North-Eastern Railway Companies, and from the Hendon Rural District Council, but it was confined to clause matters. Nevertheless, one or two important matters of principle were raised; and it is more than probable that, as a result of the inquiry, steps will be taken to fight out the issue which exists between railway companies and gas undertakers in regard to the obligations of the latter to supply gas from mains of insufficient capacity for purposes other than lighting or domestic use.

The Pinner Gas Company were represented by Mr. A. J. Lees (Messrs. Lees & Co., Parliamentary Agents); the Middlesex County Council by Mr. Alfred Tylor; the Railway Companies by Mr. H. R. Cripps; and the Hendon Rural District Council by Mr. K. de Ferrars.

Mr. Lees, in his opening statement, said that the Company were registered under the Companies Act many years ago, and obtained their first Provisional Order in 1881; while further Orders were obtained in 1901 and 1910. The development was almost phenomenal. In 1903 the sale of gas was 20 million c.ft., in 1913 it had increased to 70·2 millions, and in 1923 it had reached the figure of 132·6 millions. In twenty years the sale had been increased 6½ times, and, when allowance was made for the war period of 4½ years, he did not believe such an increase could be equalled by any gas undertaking in the country. It was also an exceedingly well-managed Company. The increased sale had necessitated obtaining additional lands for gas-works. A site had been purchased, and one of the chief objects of the Order was to sanction the use of the land, which had been bought by agreement, for the purpose of storing and manufacturing gas. They had obtained the consent of the owners and occupiers of the two or three houses within 300 yards of the site to put up a holder, and there was no opposition to that proposal. As to capital, powers were sought to raise a further £70,000 of new capital, and to borrow up to half of the amount issued. The Company had exhausted their share capital powers. Recently they had had £27,000 unissued, but an issue of 6 p.ct. preference stock was made a few days ago. This was oversubscribed, and went at a premium. There was no opposition to the increased capital powers asked for in the Order.

Mr. *George Evetts* (who has acted as Consulting Engineer to the Company for the last five years) gave evidence with regard to the new works and the capital provisions. It had been found necessary, he said, to erect a new gasholder, and, there not being sufficient room at the existing works, they had bought a site of 13½ acres, by agreement, and had erected a holder with a capacity of half-a-million c.ft. Also, complaints had been made to the Gas Referees with regard to the pressure at which gas was supplied in parts of the district, and the Gas Referees had given the Company until the end of August to rectify the difficulty. Consequently, the Company were now engaged in erecting another gasholder and laying mains for this purpose. A site comprising about ¼ acre had been secured in a convenient situation for the erection of the holder, which would have a capacity of 60,000 c.ft., with provision for telescoping in order to double this capacity. With regard to capital, Mr. Evetts said the capital commitments were £45,000, but a few days previously they had raised £27,000 by exercising their unexhausted capital powers, so that the commitments had been reduced to £18,000. The remaining borrowing powers were £13,500, so that, even if this were raised, they would still have a debit balance of approximately £4500. It was estimated that they required capital to meet extensions until June, 1935, of no less than £106,000. The additional capital powers asked for were £70,000, with £35,000 borrowing powers, making a total of £105,000. Deducting from this the £4500 debit balance, they would have a little over £100,000 available for future expenditure.

Mr. Lees then dealt with the objection of the Middlesex County Council, which related to the power to lay pipes for ancillary purposes. [The clause in question gave power for the laying, maintenance, and renewal of pipes for the conveyance of oil and other materials or residual products to and from the works, and applied the provisions of the Gas-Works Clauses Act, 1847, with respect to the breaking-up of streets for the purpose of laying pipes, and for their protection, so far as they were applicable.] The clause, said Mr. Lees, was the ordinary one which had been commonly inserted in Gas Acts and Orders for some years past, and, in the form in which it appeared in the present Order, it had been inserted by Mr. Honey in the following Orders during the past eighteen months: 1923—East Kent, Southend-on-Sea, Ipswich, and Burton-on-Trent; 1924—Accrington, Tynemouth, Eastbourne, and Brownhills. Mr. Lees said he did not understand what the opposition to the clause was. The pipes would be similar to the ordinary gas-pipes, and would be laid under the same conditions. The Company would be subject to all the obligations under the Gas-Works Clauses Act; and when such pipes were to be laid, the road authority received a notice, a plan, and a section. If they were dissatisfied, they could go to the Justices and have the position of the pipes determined; and the Company were in the same position as they would be if they were laying a high-pressure main of greater diameter. The County Council had suggested that the Company should buy lands for the purpose of laying these pipes, but he had never heard that suggestion made to the Board of Trade before. He also commented upon the effect it would have upon the price of gas.

Mr. Tylor said he was not raising this point at all. The point was that though pipes for ancillary purposes were important to a gas company, they were in a category different from that of pipes for gas supply. The necessity for pursuing certain routes along roads was less stringent than in the case of pipes carrying supplies of gas to consumers. The protection afforded by the Gas-Works Clauses Act was not sufficient. Under that Act notice had to be given, and a plan had to be submitted for approval. If it were not approved, the County Council had themselves to submit a plan; so that the right to break-up the road at some point or other was an inherent right, and the question was merely one as to how it should be done. The County Council were of the opinion that this was not sufficient protection, in view of the changed conditions of traffic and road maintenance, and suggested that the clause should be amended so as to provide that the Company must obtain the consent in writing of the local authority of the district before laying, repairing, or renewing, pipes for ancillary purposes. He was not asking for anything novel or unfair, and he mentioned a number of Provisional Orders in which the power to break-up streets for laying these pipes was subject to the consent of the local authority being obtained. This was a recognition that the protection afforded by the Gas-Works Clauses Act was not sufficient. In the case of the Brentford Gas Company's Act, though the usual powers were given for laying pipes for the supply of gas, in regard to the laying of pipes for ancillary purposes they were limited to an area within a radius of a mile from the works, and the laying of the pipes was made subject to the consent in writing of the proprietors of the Grand Junction Canal. Mr. Tylor agreed with Mr. Lees that that provision had reference only to the towing path of the canal, but he held that it was usual to apply more stringent provisions to the laying of pipes for ancillary purposes than to the laying of pipes for giving a direct supply of gas. This was not a fractious opposition. The County Council were the road authority in some cases, and in others, by reason of certain sections of the Local Government Act of 1888, they were obliged to contribute towards the cost of roads the control and management of which were not directly in their hands, so that they had both a direct and an indirect interest as to where and how pipes were laid. There were a number of important arterial roads running through the Company's area of supply.

Mr. Lees, referring to Mr. Tylor's precedents, said they were Provisional Orders made under the Gas and Water Works Facilities Act. They could not have been made without the consent of the local authorities, and, in order to get their consent, the promoters, wisely or unwisely, had accepted the amendment so as to get along with the Order. But it had nothing to do with County Councils. A "local authority," under the Gas and Water Works Facilities Act, meant the local authority of the district—borough, urban, or rural council—and Mr. Tylor had not given a single case in which this protection had been given to a County Council. He challenged Mr. Tylor to produce a case where a County Council had obtained the amendment, and where they had had a veto on the laying of these pipes. The County Council were fully protected by the Gas-Works Clauses Act; and he asked Mr. Honey not to put the Company under an obligation which no other gas company in the country was under.

After further discussion, Mr. Honey intimated that he was not prepared to recommend unlimited powers over the very large area supplied by the Company.

It was then suggested by Mr. Frank Jones (Chairman of the Company) that the power asked for in the draft Order should be given, but should be limited to an area within a radius of a mile from each of the works. Mr. Tylor did not think this would really meet the County Council, because that was a particularly bad part of the area. They did not want an absolute veto, but were ready to submit any differences to an authority, such as the Minister of Transport. Mr. Lees objected to going to the Minister of Transport, on the score of expense, and pointed out that if this power were limited to within a mile of the works, the County Council would be better off than they were in respect of other gas companies. There was apparently no road in that area which was repaired by the County Council, so that they had no *locus*, and why should the Company get their consent? Mr. Tylor replied that they had an interest, because they paid 25 p.ct. of the upkeep of the roads; also, the County Council could at any moment declare a road to be a main road, and could put a road under their jurisdiction. Another suggestion by Mr. Tylor, in an attempt to reach agreement, was the adding of words to provide that consent should not be unreasonably withheld.

Mr. Honey said he would not give a decision immediately.

Mr. Cripps then raised the Railway Companies' objection to the clause in the Order relating to mains of insufficient capacity. The clause in question is taken from the House of Lords Model Bill, 1922, and is as follows:

> "Notwithstanding anything contained in any enactment to the contrary, the Company shall not be obliged to give from any main a supply of gas for any purpose other than lighting or

domestic use in any case where the capacity of such main is, at the date when the supply is demanded, insufficient for such purpose, or if and so long as any supply for such purpose would, in the opinion of the Company, interfere with the sufficiency of the gas required to be supplied by means of such main for lighting or domestic purposes."

It was stated by Mr. Cripps that the Railway Companies objected to this clause, and that they had tried to fight the matter out before Parliamentary Select Committees on several occasions, but that the promoters of the Bill or Order which they were opposing had in each case withdrawn the clause. This was a position which the railway companies ought not to be put into continuously. Mr. Lees replied that if the Railway Companies fought the matter in this case, the Company intended to take it to a Select Committee, and he could give an undertaking that if the Railway Companies got someone to put down a motion, when the Order went to the Houses of Parliament for approval, to refer it to a Select Committee, it would be accepted by the Gas Company. Mr. Cripps, in these circumstances, agreed that it was, perhaps, advisable to reserve any opposition the Railway Companies might have to the clause until it could be brought before a Select Committee; it being understood that the Railway Companies would not be in the position of having engaged Counsel and witnesses merely to hear Mr. Lees withdraw the clause objected to. Mr. Lees assured Mr. Cripps that the Pinner Company would not run away.

The matter was left there, with Mr. Honey's concurrence.

Mr. CRIPPS then turned to the clause in the Order enabling the Company to contract for supplies in bulk. [This is the model clause enabling the Company to give a bulk supply to, or receive a bulk supply from, any local authority, company, or person, upon agreed terms, but providing that the Company should not be authorized to lay mains or interfere with streets beyond the limits of supply.] He asked for a proviso, which was contained in the Pinner Company's Order of 1901, as follows:

> "Provided that no contract entered into under this section shall entitle any local authority, company, or person to demand, and the undertakers shall not give, a supply of gas if and so long as such supply would prejudice the supply of gas by the undertakers within the limits of supply."

Mr. Cripps' objection was that the clause in the present Order took away from the Railway Companies the protection given under the 1901 Order. The Railway Companies used a certain amount of gas in this area; and so long as the supply in bulk would not interfere with the ordinary supply in the area, they were content. But apparently the object of the present clause was to enable the Company to supply gas in bulk outside the area to an extent which would prejudice the supply within it. The Gas Company could not object to the proviso unless it was their intention to supply in bulk to the prejudice of supplies within the area.

Mr. LEES said that the Gas Company's only objection to this proviso was that anyone who contemplated taking a supply in bulk from the Company would refuse to enter into a contract, because the supply might be cut off at any time. The clause would not be workable, and no doubt Parliament had discovered this when they had altered the model clause by striking out that proviso.

Mr. HONEY asked in what way it was suggested that consumers might be prejudiced.

Mr. CRIPPS said that the Company might be getting a price for a supply in bulk outside the area which would give them a better return than they obtained from the gas sold within, and therefore it would be in their interests to supply outside, to the prejudice of the supply for which they obtained the lesser return.

Asked by Mr. Honey what he meant by "prejudice," Mr. Cripps said he meant interference with the supply by reduction of quantity or of pressure.

Mr. LEES pointed out that under the Gas Regulation Act the Company were bound to give a pressure of 2 in.; the Railway Companies were guaranteed this pressure, and the Gas Company were subject to penalties if they failed to give a supply or to maintain the pressure.

After further discussion, Mr. Honey said the objection was altogether too far-fetched.

Mr. CRIPPS said that, if the clause were allowed without the proviso, it would be making a substantial alteration in the procedure adopted hitherto. There were eight Gas Orders made in 1924 in which this proviso was inserted.

Mr. LEES said the inclusion of the proviso was consented to in each case by the gas undertakers, but now, for the first time, the Railway Companies were meeting a Gas Company who were not going to run away. The Company were satisfied that the clause, with the proviso, was unworkable, and wanted this matter, as well as the clause with regard to supply from mains of insufficient capacity, determined by a Select Committee.

Mr. CRIPPS said that in these circumstances he would ask to proceed elsewhere. He agreed that the point was not of so much substance as the previous one, but it was a question of principle.

The objections of the Hendon Rural District Council were then dealt with.

Mr. DE FERRARS, on their behalf, raised objection to the stand-by clause in the Order. [This precluded anyone from demanding a supply of gas for premises for which he had a supply of gas from an installation other than that of the Company, or a supply of electricity, unless he agreed to pay a minimum annual sum which would give the Company a reasonable return on the capital expenditure and would cover charges incurred by them in order to meet the possible maximum demand for those premises; the sum to be paid should be determined, in default of agreement, by arbitration.] This would operate unfairly, said Mr. de Ferrars, on small consumers. The attitude of the Hendon Rural District Council was that there might be two or three families in a house, one, possibly, with a supply of electricity, and another with no installation at all, but desiring a supply of gas. The Gas Company, under this clause, could say to this family that either they could have no gas at all or they must have it on the Company's terms; and the consumer would have to accept their arbitrary terms or become involved in expensive litigation.

Mr. LEES said that Mr. de Ferrars could not possibly have known that similar provisions were contained in the Electricity Act, and that the clause merely gave the Gas Company the same provisions as were applied to electricity undertakings throughout the whole country under the general law. Also, the clause had been given to all gas companies who had asked for it in recent years.

Mr. DE FERRARS challenged Mr. Lees to point out any Gas Order in which the clause appeared, and held that it was not a common clause.

Mr LEES maintained that it was in every Order made by the Board of Trade.

Mr. DE FERRARS replied that, even if this were so, it was a matter which should be weighed on its merits in every case.

In the course of further discussion it was suggested by Mr. Lees that small consumers did not usually have a stand-by; but Mr. de Ferrars said it often happened that there were two families in a house, one consuming electricity and the other burning gas. Asked by Mr. Honey if he would call that a stand-by supply, he said he was not cognizant with the technical details of the matter. Mr. Honey said, however, that he would put in the words "for stand-by only," and would follow exactly the wording of the Electricity Act. Parliament had recently decided that this provision was reasonable; and if it were reasonable for electricity, it was surely reasonable for gas.

Mr. DE FERRARS intimated that the Hendon Council would have no objection, if the provisions of the clause were limited to a stand-by supply.

Mr. *Evetts* remarked that this would also cover the man who used electricity for lighting and gas for cooking.

The only other objection raised by the Hendon Council related to the provisions as to the construction and placing of pipes in premises by the owners or occupiers, to enable the Company to ensure a satisfactory supply of gas to their consumers. [This was the model form of clause.] The objection was that the clause provided for notices to be given to the Company when pipes or fittings were to be fixed, with a description of them. Then the Company could make any inspection they considered necessary, and intimate their approval or disapproval. The pipes and fittings must not be fixed until approved; and when they were fixed, further notice had to be given to the Company, and the pipes and fittings must not be covered until after 24 hours from the service of the notice, or until they had been inspected and approved. It was considered unnecessary, he said, that the pipes should remain uncovered for 24 hours for the purpose of further inspection.

Mr. HONEY said the clause in the Order had been settled by representatives of the Gas Light and Coke Company, certain property owners' associations in London, and the railway companies, after considering it in great detail. The clause, in that form, had been put before a conference held some twelve months ago between representatives of the County Councils' Association, the Urban District Councils' Association, and the Metropolitan Borough Councils, and they had unanimously recommended that, for the safety of consumers, the clause should be incorporated in Special Orders whenever companies asked for them. If a company did not put the clause into their Order, the Board generally did it, whether the company wished it or not. When it was considered that the clause was designed for the protection of the public, he did not think Mr. de Ferrars would press his objection. The pipes or fittings should be inspected by the Company concerned before they were covered over; and it should not be sufficient merely to give notice that such-and-such a pipe was to be put in such-and-such a wall—the Company should have the fullest opportunity of looking at the pipe before it was too late.

Mr. de FERRARS said that, having regard to Mr. Honey's remarks, he merely put forward the Hendon Council's objection and left the matter in Mr. Honey's hands.

This concluded the inquiry.

BOLTON CORPORATION GAS ACCOUNTS.

Reporting to the Town Council upon the results for the year ended March 31, the Bolton Gas Committee state that the quantity of gas made was 1,178,961,000 c.ft., compared with 1,122,210,000 c.ft. in the previous year. The Committee state that the year's work has been most gratifying, and congratulate the Engineer (Mr. W. J. Smith, B.Sc.) and his staff on the excellent results.

The accounts, prepared by Mr. W. J. Jeffries (the Borough Treasurer), show a gross profit of £78,751. The sum of £18,000 has been placed to the depreciation and renewals fund, the revenue contributions to capital amount to £7321, and a balance of £19,922 remains to be carried forward.

The Gas Supply of Shaldon.—Mr. R. E. Cox, Ministry of Health Inspector, held an inquiry at Teignmouth respecting the Urban District Council's application for sanction to borrow £6874 for the purpose of extending the gas-works to supply the neighbouring district of Shaldon, and to meet future requirements. The inquiry was largely attended, and there was some opposition. Mr. A. P. Dell, Solicitor to the Council, explained that not only was the capacity of the holders insufficient to supply Teignmouth alone, but there was a great demand from Shaldon for slot-meter installations. The ratepayers of that area were entitled to have a supply of gas, even if it resulted in a financial loss. The extension would mean carrying the high-pressure mains across the River Teign. Mr. H. Higham, the Gas Manager, stated that during the year ended March last the increased sales of gas amounted to 12½ p.ct. There was no margin of reserve at the works. An overwhelming majority of ratepayers had at a public meeting favoured the proposed extension. Mr. P. P. Lloyd, of Shaldon, did not think it would be a paying proposition, while Mr. R. E. Harris, who also opposed, said that possibly the town would have to borrow £40,000 or £50,000 shortly for an increased water supply. Major Hawkins declared the gas supply was unsatisfactory, and they should not allow any more money for it.

FLUELESS GAS-STOVES.

The Recent Joint Committee Report.

(*Concluded from p. 760.*)

HUMIDITY.

Something of the order of 400 grains of water are produced per cubic foot of gas burnt, and about 500 B.Th.U. of heat, according to the nature of the gas. In stoves not equipped with flues, all this water is delivered into the room, and the humidity of the air is likely to be increased; whereas with a stove or fire provided with a flue, the water is carried away, and as the temperature is also raised there is a tendency to lower the relative humidity. But water is often supplied from the inhabitants of the room, and the walls and furniture. A man breathes out roughly 700 grains of water per hour, and produces about 446 (gross) B.Th.U. per hour, about one-quarter of which is used in evaporating the water, leaving 340 B.Th.U. as the net heat produced by an adult per hour (ref. 11, p. 61).

In tests of gas stoves carried out by Owens (ref. 6), out of 23 stoves with flues 20 produced a reduction in relative humidity, varying from 2 to 11 p.ct., and 3 produced an increase. Of 8 flueless stoves, 4 produced an increase in relative humidity, 1 no effect, and 3 a reduction, probably due to ventilation. From Brearley's tests of stoves with flues (ref. 7), out of 12 tests, 2 showed no effect on humidity, 2 showed an increase of about 2½ p.ct., and 8 showed a reduction of over 20 p.ct., between 10 a.m. and 4 p.m. I find, however, that taking account of temperature, all 12 showed a considerable increase in the amount of moisture present in the air. It is obvious that gas fires or burners unprovided with flues must increase the moisture content of the air by the addition of the moisture produced by combustion; and this, added to moisture derived from other sources—such as respiration—may make the room, if not well ventilated, unbearable.

As to the hygienic effect of humidity, a humidity of about 70 p.ct. is considered as providing the most agreeable atmosphere. Leonard Hill states (ref. 15) that in hot moist rooms the quantity of oxygen breathed is considerably reduced, since the vapour pressure displaces some of the air. A warm moist air reduces evaporation from the body and from the respiratory tract, and therefore the activity of the circulation through the tissues. "The expanded parts of the lung are not swept with blood." "Everything favours a lodgment of the bacilli, and lessens the defences upon which immunity depends" (*ibid.*, p. 193). An increase in tuberculosis in Norway has resulted from the substitution, for old cottage fireplaces with wide chimneys, of American stoves with small flues. In the report of the Royal Commission on humidity and ventilation in cotton and weaving sheds (ref. 19), the general conclusion was that the degree of discomfort experienced by workers in a hot moist atmosphere is measured not by the temperature of the air, nor the absolute percentage of the water present, but by the temperature of the wet-bulb thermometer. If this exceeds about 78° Fahr., hard work becomes impossible. Above about 88° Fahr. it becomes impossible for ordinary persons even to stay in still air. If the air is in motion, the limit extends upwards considerably.

Dr. L. Hill believes that cooling power, as measured by his Kata thermometer, is the factor governing the effect of the air upon workers. The limits of a man's power of accommodation in still air are passed when the wet-bulb exceeds 88° to 90° Fahr., even when the man is stripped to the waist and doing no work (ref. 20). Movement of the air raises the critical wet-bulb temperature so that a higher temperature can be borne. Working in warm moist air, approaching the critical wet-bulb temperature, causes a rise of body temperature owing to the checking of evaporation. Osborne (ref. 21) recorded, after 78 minutes exposure in a hot moist room, with a dry bulb of 94·8° to 100·3° and a wet-bulb of 89° and 96°, that the body temperature rose to 103°, the pulse rate to 168, and the systolic blood pressure from 112 to 142.

VENTILATION.

The volume of air moved by a gas-fire fitted with a flue may be between 2000 and 5000 c.ft. per hour, depending upon the area and length of flue and the quantity of gas burnt. In Owen's tests (ref. 6), the volume of air per cubic foot of gas burnt ranged from 34 to 168 c.ft., the diameter of the flue being 9 in. and the height about 68 ft. Yates' tests (ref. 9) with a special ventilating fire, using a flue 30 ft. high, showed a ventilating effect of 11,800 c.ft. per hour, while ordinary gas-fires gave 4500 to 5000 c.ft. per hour.

Owens showed (ref. 6) that the ventilating effect can be increased three to four times by allowing the draught from the stove flue to induce a flow of air into the chimney through other openings, the volume being raised in certain cases up to between 10,000 and 12,000 c.ft. per hour.

The Ventilating Research Committee of the Institution of Gas Engineers (ref. 1) aimed at ascertaining: (1) The volumes of air moved under the most favourable conditions and under other definite conditions by a gas-fire; and (2) the relative efficiency of a number of gas-fires under these conditions.

Rideal says (ref. 13) the products of a gas-stove consist of carbonic acid, aqueous vapour, and sulphur acids. Roughly speaking, 5 c.ft. of coal gas produce 2½ c.ft. of carbonic acid, 6½ c.ft. of aqueous vapour, and consume about 5½ c.ft. of oxygen. One would expect from this quantity of gas 2 to 3 grains of sulphur oxidized to sulphurous or sulphuric acid. He refers also to flueless condensing stoves, and gives a table showing the effect on the oxygen content of the room after burning for one, two, five, and six hours; but this appears to be based on the assumption that the stove liquefies the whole of the water produced, and he appears to assume that this condensation ultimately results in the bringing-in of fresh air from outside owing to the contraction of volume, since the water condensed occupies practically no volume compared with the oxygen required to produce it. Thus with a stove consuming 10 c.ft. of gas per hour, and (say) 11 c.ft. of oxygen, derived from 55 c.ft. of air, after one hour's burning the 11 c.ft. of oxygen will be replaced by 5 c.ft. of CO_2—a contraction equal to about 6 c.ft. in the total room space, which must be filled by an influx of a fresh supply of outside air. Arguing on these lines, Rideal says that the oxygen reductions are very small, and roughly equal to twice the volume of CO_2 produced; so that if a room contains 25 c.ft. of CO_2 in the 4000, after five hours, or 0·625 p.ct., the quantity of oxygen in the room will have diminished from 800 volumes to 750, or 1·4 p.ct. He states that a man delivers less than 1 c.ft. of CO_2 per hour, or (say) one fifth of that of the gas-stove considered.

Relative to the absorption of CO_2 by the water condensed by a flueless stove, Rideal says: "As it only dissolves about its own volume of CO_2, it cannot absorb more than 1/500 p.ct. of the total amount of this gas formed." The quantity of CO_2 absorbed is therefore negligible. Rideal concludes as follows: "I am inclined to add that, from the considerations I have put before you, flueless gas-stoves, especially those of a condensing type, are also indicated as an aid to defective ventilation."

LOSSES IN FLUES.

The subject of heat losses in the flue of a gas-fire is considered here as bearing upon the gain in efficiency of a fire when there is no flue.

James Yates (ref. 8) found that different sized modern gas-fires, attached to a chimney 30 ft. high, gave approximately: Radiant heat, 50 p.ct.; loss in flue gas, 30 p.ct.; convected heat, 20 p.ct. Brearley's tests (ref. 7) showed for eight different types of fires with flues losses ranging between 7·7 and 33·1 p.ct. in the flue gases; the outlet temperature of the flue gases ranging from 48·2° to 110·3° Fahr. These losses are based upon the heat carried out of the flue by the hot gases (above the room temperature). The flue here was 22 ft. long, hence the somewhat high losses. In Owens' tests (ref. 6) the percentage of heat *passed out* of the flue at the top, for eight different stoves, varied from 0·11 to 8·04, the flue in this case being 68 ft. high. It is important to notice here that the figures in these cases depend upon the height of the flue to a very great extent. It is obvious that, if the flue be high enough, all the heat can be abstracted from the flue gases before they are emitted at the top, and it is hardly right to refer to the heat which *enters* the flue as being lost. For an ordinary building, I think the figures given by Yates may be taken as reasonably representative, the heat discharged from the flue being about 30 p.ct. of the total. In the absence of a flue, this heat is discharged into the room, and represents the maximum gain of efficiency which can be obtained by using a flueless stove. In the case of flueless gas-fires for heating, it should be kept clearly in mind that there is a great temptation to restrict the ventilation in order to economize heat; and whatever may be the intention of the makers of such fires, the user will often be found closing all openings which admit air to the room, in order to get a comfortable heat. This will always be a dangerous factor in the use of such stoves. Broadly speaking, the conditions which produce adequate ventilation are opposed to those which make for a warm air, and this is the source of danger.

SUMMARY.

To summarize, when using flueless fires:

(*a*) There is a problematical saving of up to 30 p.ct. in heating efficiency by abolishing the flue.
(*b*) The quantity of CO_2 and water in the air of a room are greatly increased.
(*c*) Sulphur in the gas contaminates the air in the form of SO_2 or SO_3.
(*d*) The ventilating effect is practically *nil*.
(*e*) If there is a leakage or the gas-tap is not fully closed, the gas escapes into the room.
(*f*) If combustion is imperfect, owing to wrong design, the stove going out of order, or being incorrectly used, poisonous products—such as CO—escape into the room.
(*g*) There is a great temptation for users to restrict ventilation purposely, so as to economize heat.

REFERENCES.

1. Institution of Gas Engineers, Ventilation Research Committee. "Trans.:" 1914, pp. 1, 2, 3; 1915, p. 57; 1916, p. 98.
2. Institution of Gas Engineers, Gas Heating Research Committee. "Trans.:" 1909, p. 59; 1910, p. 156; 1911, p. 82.
3. Departmental Committee on Carbon Monoxide. July, 1921.
4. Fishenden, R. B. "The Account of the Work hitherto carried out in Relation to Gas-Fires."
5. "Lancet." "Gaseous Fuel, Gas Heating, and Gas Cooking Appliances." Nov. 25, 1893.
6. Owens, J. S. "Gas-Stoves." Report upon an Experimental Enquiry. "Lancet," Nov. 17, 1906.
7. Brearley, J. H. "The Testing and Hygienic Efficiency of Gas-Fires." "JOURNAL OF GAS LIGHTING," June 25, 1907.
8. Yates, H. J. "Recent Progress in Gas-Fire Science." British Association, 1913. Published in "Engineering," Oct. 10, 1913.
9. Yates, H. J. "Gas Heating and Smoke Prevention." British Association, 1915. Published in "Engineering," Oct. 15, 1915.
10. Hartley, H. "Gas-Fire Development, 1913 15." "JOURNAL OF GAS LIGHTING," Nov. 16, 1915.
11. Rideal, S. "Relative Hygienic Values of Gas and Electric Lighting." R. San. I., 1908.
12. Barker, A. H. "Theory and Practice of Heating and Ventilation."
13. Rideal, S. "Advantages and Disadvantages of Heating Buildings with Gas Stoves of Various Types." R. San. I., 1907.
14. "JOURNAL OF GAS LIGHTING." Nov. 24, 1903. "Combustion Products of Gas and Oil Stoves."
15. Hill, Leonard. "Science of Ventilation and Open Air Treatment." Part 2, 1920.
16. Owens, J. S. Abstract of Report on Tests of Gas Stoves. R. San. I., Vol. 28, No. 2, 1907.
17. London County Council, Public Control Department. Report on Gas Composition, 1922.
18. Lewes, V. B. "Liquid and Gaseous Fuels."
19. Home Office, Royal Commission on Ventilation in Cotton Weaving Sheds.
20. Haldane. "Journal of Hygiene," 1905.
21. Osborne. "Proceedings of Royal Society," 1920.

THE NORTH-EAST COAST COAL TRADE.

From our Own Correspondent.

There is no improvement to report this week, and trade is still at an extremely low ebb. The short production due to the Whitsuntide holiday has not benefited the market. Some profess to have found a better feeling this week; but it has certainly not been evidenced as yet in the advent of new business. It probably originates in the fact that prices have absolutely reached rock bottom, and that collieries must work short time rather than accept business at any further reductions. It may be that this will induce Continental buyers to place orders, if they realize that they cannot entirely call their own price. And orders are badly needed.

As regards gas coals, Wear Specials are quoting 24s., but best qualities (Holmside, Boldon, New Pelton class) have been about the firmest spot this week at 23s. Some of the colliery towns are full, and they are able to hold out for this figure. But, generally speaking, quoted prices can be discounted by those who have tonnage to suit the colliery books. Seconds are called 20s. to 21s.

COAL TRADE IN THE MIDLANDS.

From our Local Correspondent.

A good many contracts have now been completed for supplies of gas coal over the next year. Buyers are not able to get any better terms than those which apply to earlier commitments. The rate of advance on the previous year's prices varies according to the circumstances of individual collieries. Some of them are still standing out for more than engineers are inclined to concede, on the hazard of the market hardening as the unsold balance diminishes. On the other hand, there are big undertakings, whose weight of business always ensures them the most favoured terms, who can afford to hold off till the last moment, at any rate as regards a considerable proportion of their requirements. They are still feeling their way very cautiously. As regards industrial fuel, the situation has undergone very little change. Demand keeps flat. The general tendency is towards easier conditions.

Only an insignificant amount of trade is passing in household qualities. A waiting policy is encouraged by collieries who, it is assumed, have not yet announced their final summer prices. Agents say that in the circumstances they are unable to advise customers, not convincingly, at all events, that they would be wise to lose no time in stocking against the winter. It is expected, however, that when stability is reached, a large number of domestic consumers will be anxious to guard themselves, before the summer is far adavnced, against contingencies of which they had unpleasant experiences during the past busy season. Output is greatly reduced.

YORKSHIRE AND LANCASHIRE COAL TRADE.

From our Local Correspondent.

There is little change to report this week in the state of the coal trade in Yorkshire and Lancashire. The Whitsuntide Holidays were responsible for a certain amount of dulness in business last week. House coal is, owing to the warmer weather, moving very slowly. Industries do not appear to have revived; the stocks accumulated a little time ago apparently proving sufficient for immediate needs.

Gas coals have been quoted under contract at from 1s. to 2s. in advance of last year's prices, but whether these will be maintained is a matter of conjecture. The outlook for shipping is bad; the German strike, now settled, having created no increased inquiries or business for British coals. Belgium and France are not keen buyers, with the result that collieries are faced with the prospect of having to work reduced time in the near future.

Prices at Hull at the week-end were: Bunkers: Yorks, Derby, and Notts large screened steam, f.o.b. Humber ports, 22s. to 23s. Cargo for export, f.o.b. usual shipping ports: Best Yorks hards, Association, 24s. 10½d. to 25s.; Derby best hards, 24s. 6d. to 25s.; West Yorks Hartleys, 22s. to 24s.; South Yorks washed doubles, 23s. 3d.; South Yorks washed singles, 23s.; dry doubles, 18s.; South Yorks washed smalls, 17s. 6d.; Derby slack, 1 in., 14s. 6d. to 15s.; South Yorks rough slack, 15s. 3d. to 15s. 6d.; gas coke, 35s. to 35s. 6d.; foundry furnace coke, 25s. to 26s.; washed smithy peas, 25s. to 29s. 6d.; washed steam thirds, 22s.; South Yorks washed trebles, 23s. 6d. per ton.

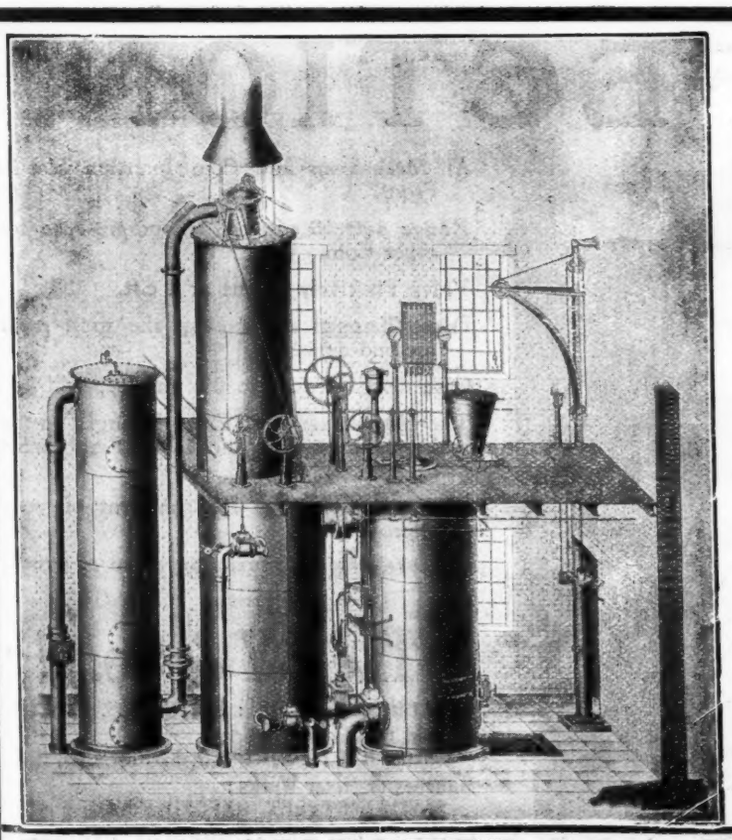
The demand in Lancashire has been slack for the last month. Nominal prices at the collieries remain unchanged, but no doubt concession would be made to secure business.

TRADE NOTE.

New Sulphate Plant for Derby.

We learn that the Chemical Engineering and Wilton's Patent Furnace Company, Ltd., of No. 76, Victoria Street, S.W., have been instructed by the Derby Gas Light Company to supply and erect an entirely new sulphate plant complete.

Tayport Gas Price Reduced.—At a meeting of the Tayport Town Council, Mr. R. A. Hardie (Gas Convener), in moving the reduction of the present price of gas by 5d. per 1000 c.ft., pointed out that a gross profit of £2270 had been made. Deducting interest charges, this left £750 towards the reduction of debt, which was the best financial result since the municipalization of the gas-works.



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CURRENT SALES OF GAS PRODUCTS.

Tar Products in the Provinces.

June 16.

The average values for gas-works products during last week were: Gas-works coal tar, 49s. 9d. to 54s. 9d. Pitch, East Coast, 59s. to 61s. 6d. f.o.b. West Coast—Manchester, 55s. to 57s. 6d.; Liverpool, 56s. to 58s.; Clyde, 57s. to 59s. Benzole 90 p.ct., North, 1s. 5d. to 1s. 6d.; crude 65 p.ct. at 120° C., 1s. to 1s. 1d. naked at makers' works; 50-90 p.ct., naked, North, 1s. 8d. to 1s. 10d. Toluole, naked, North, 1s. 5d. to 1s. 6d., nominal. Coal tar crude naphtha in bulk, North, 7½d. to 8d. Solvent naphtha, naked, North, 1s. 4d. to 1s. 5d. Heavy naphtha, North, 1s. 2d. to 1s. 3d. Creosote, in bulk, North, liquid, 7⅛d. to 7¼d.; salty, 6⅞d. to 7⅛d.; Scotland, 6⅞d. to 6⅞d. Heavy oils, in bulk, North, 9d. to 9¼d. Carbolic acid, 60 p.ct., 1s. 11d. to 2s. 1d. prompt. Naphthalene, £15 to £16; salts, £6 to £8, bags included. Anthracene, "A" quality, 4d. per minimum 40 p.ct., purely nominal; "B" unsaleable.

Cheaper Gas for Carnoustie.—The price of Carnoustie gas for the current year has been fixed at 5s. 2½d. per 1000 c.ft. for ordinary meters, and at 5s. 7½d. for slot meters; being a reduction of 5d. per 1000 c.ft. This will mean a concession of £800 to consumers.

Wirksworth Gas Price Reduced.—It is announced by the Directors of the Wirksworth Gas Company that they have decided on a further reduction in the price of gas of 2½d. per 1000 c.ft., bringing the charge for lighting purposes to 6s. 8d. per 1000 c.ft. and for power to 6s. 3½d. The total reduction since 1921 amounts to 1s. 8d. per 1000 c.ft.

Garage in a Gasholder.—A large disused gasholder is to be converted into a garage in Berlin. It will be ten storeys high, with a spiral roadway 25 ft. wide encircling it. Each floor will have "stalls" for 100 cars and 50 motor-cycles, arranged in circular form, the centre being devoted to repair shops. Passenger lifts will also be installed.

Reduction at Dundee.—The Dundee gas rate is to be reduced by 2d. per 1900 c.ft., making the new price 3s. 4d. per 1000 c.ft. Treasurer Johnston gave figures showing a great improvement in the financial position of the Gas Department. He pointed out that at the beginning of last year there was a debit balance of £33,000, which had been reduced to £13,000. It has been calculated that, even with a reduction of 2d. per 1000 c.ft., the remaining debt will be wiped-off during the coming year.

Devonport Gas Price.—Major J. Clifford Tozer (Chairman of the Plymouth Corporation Gas Committee) foreshadowed at the last Town Council meeting a further reduction in the price of gas in the Devonport area supplied by that Corporation. The undertaking, he said, had shown a good profit, despite the fact that there had been already a notable reduction in price. It was, of course, the aim of the Committee to give good gas at the lowest possible figure.

Stratford-upon-Avon Price Reduction.—A reduction in the price of gas, as from the June meter readings, of 4d. per 1000 c.ft. to ordinary and slot consumers, and 7d. to power and industrial users, was agreed to by the Stratford-upon-Avon Town Council at their meeting on the 10th inst.

Reduction in Price at Rochester.—The Rochester, Chatham, and Gillingham Gas Company announce that the price of gas will be reduced by two-fifths of a penny per therm (equivalent to almost 2d. per 1000 c.ft.) as from the date of reading the ordinary meters for the quarter ending June 30.

Bognor Gas Company Capital Issue.—The tenders for the £13,000 of 6 p.ct. redeemable debenture stock which Messrs. A. & W. Richards offered on behalf of the Bognor Gas Light and Coke Company amounted to £71,600. They ranged from £105 per £100 down to the minimum of par, and the lowest price to secure an allotment was £101 2s. 7d. per £100.

Another Victory for the Davis Fire Brigade.—The Davis Fire Brigade again won the Cup at the Luton and District Private Fire Brigade competitions held on May 31, making the third victory in five years. There were seven brigades competing, the competition throughout being very keen indeed; and the cup (given for the lowest aggregate time) was won only by ⅘ sec. from the nearest competitor. The Mayor of Luton paid a tribute to the private fire brigades of the large works in Luton, describing them as a great asset to the town, and added that no firm had greater cause to be proud of the efficiency of their brigade than the Davis Gas Stove Company, Ltd. The Davis Brigade have taken part in four of the annual competitions, and on each occasion they have won a prize. There were no less than nineteen prizes won by them last year, and the total number of their prizes in four years is 65.

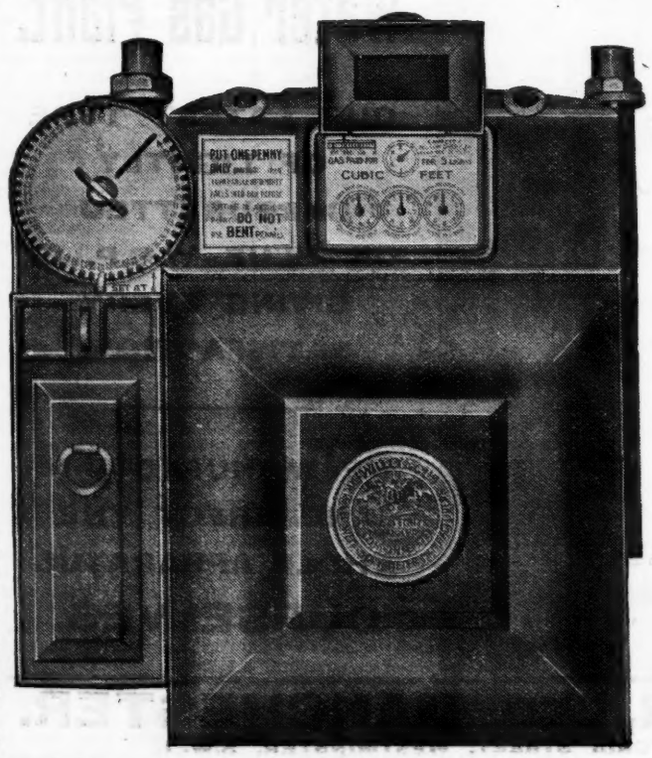
Mr. Percy Griffith, M.Inst.C.E., M.I.Mech.E., F.G.S., has removed to more commodious offices, at No. 39, Victoria Street, London, S.W. 1.

The Withnell District Council, on June 12, accepted a tender of £180 from the Standard Furnace and Setting Company for the erection of new retorts at the gas-works.

It was reported at a meeting of the Leigh Town Council, on June 11, that a net profit of £2551 had been made on the Gas and Water Department—a decrease of £2012. Big reductions had been made in the price of gas.

Electric light and motive power users, tramway passengers, entertainment house proprietors, and all dependent on electricity at Barrow-in-Furness, found themselves without supply for between one and two hours—according to the nature of the requirement—between 8.15 and 10 p.m. on June 12, owing to a small outbreak of fire at the Corporation electricity works, which cut off the whole of the town's service.

PERFECTION.



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STOCK MARKET REPORT.

FOLLOWING the Whitsun Holidays, business was on the small side on the Stock Exchange last week. The resignation of the French President came as a surprise, and there is a disposition to attribute to the new Government a more lenient view of the reparations question. As a consequence, French francs, which had depreciated to 86, recovered sharply, and at one time were dealt in below 80.

British Government Stocks showed fractional improvements on the week, the 5 p.c. War Loan closed at 101$\frac{9}{16}$, and the Conversion Loans at 98 for the 4$\frac{1}{2}$ p.c. and 78$\frac{9}{16}$ for the 3$\frac{1}{2}$ p.c. Underwriters had to take up 85 p.c. of the New South Wales £10,000,000 Loan, and dealings opened at 1$\frac{1}{2}$ discount. In spite of the opposition of the Parent Tyre Company, who are large holders in Dunlop preference shares, the Directors of the latter Company have intimated that they will proceed with the reconstruction scheme.

There was some activity in the Oil Market, mainly in Lobitos, Anglo Ecuadorian, British Controlled, and Phœnix, all of which showed improvements in price. The collapse of the tube strike, which the unofficial leaders attribute to the action taken by the National Union of Railwaymen, brought about a little activity in Underground shares.

Gas stocks remained steady, and, with the exception of *ex* div. quotations, no material changes in price were recorded.

The following transactions were recorded during the week:

On Tuesday, Aldershot "C" 81, Brentford 5 p.c. preference 91, British 117$\frac{1}{4}$, 118, Commercial 3$\frac{1}{2}$ p.c. 91$\frac{1}{2}$, European 6$\frac{1}{4}$, Gas Light and Coke 93$\frac{1}{2}$, 93$\frac{3}{8}$, 3$\frac{1}{2}$ p.c. maximum 62$\frac{1}{2}$, 63, 63$\frac{1}{8}$, 4 p.c. preference 81, 82, 3 p.c. debenture 62$\frac{1}{2}$, 64, Imperial Continental 151$\frac{1}{4}$, 152 *ex* div., Primitiva 4 p.c. debentures 73$\frac{3}{8}$, 73$\frac{1}{4}$ *ex* div., 4 p.c. (Buenos Ayres) debenture 56, 4 p.c. (River Plate) debenture 56, 57, South Metropolitan 98$\frac{1}{2}$, 99, 99$\frac{1}{4}$, South Suburban 104. Supplementary prices, Aldershot new "C" 80$\frac{1}{2}$, 81$\frac{3}{4}$, South Suburban 7 p.c. debenture 105, 105$\frac{1}{2}$, Wandsworth 3$\frac{1}{2}$ p.c. new 97$\frac{1}{2}$.

On Wednesday, Alliance and Dublin 64$\frac{1}{2}$, Brentford "A" 99$\frac{3}{4}$, British 117$\frac{1}{4}$, 7 p.c. preference 123$\frac{1}{2}$, Gas Light and Coke 93$\frac{1}{4}$, 93$\frac{3}{8}$, 93$\frac{1}{2}$, 93$\frac{3}{4}$, 94, 3 p.c. debenture 62$\frac{3}{4}$, 63, Imperial Continental 150$\frac{1}{2}$, 152, 152$\frac{3}{4}$ *ex* div., Primitiva 4 p.c. debenture 73$\frac{3}{8}$, 73$\frac{1}{2}$ *ex* div., South Metropolitan 99$\frac{3}{4}$, 100, South Suburban 5 p.c. debenture 98$\frac{1}{4}$. Supplementary prices, Gas Light 10 p.c. bonds 195, Malta and Mediterranean (9 p.c. preference) 92s. 6d.

On Thursday, Bombay 5$\frac{1}{2}$, Brentford "A" 99, 5 p.c. preference 92$\frac{1}{2}$, Cape Town and District 6$\frac{3}{4}$, Commercial 4 p.c. 91$\frac{1}{2}$, 92$\frac{1}{2}$, Continental Union 27, Gas Light and Coke 93$\frac{1}{2}$, 93$\frac{1}{4}$, Imperial Continental 152$\frac{1}{2}$, South African 7$\frac{1}{2}$ *ex* div., South Metropolitan 99$\frac{1}{2}$, 100, Tottenham "B" 101, Tuscan 6 p.c. debenture 70$\frac{1}{2}$. Supplementary prices, Romford 7 p.c. "B" 8, 8$\frac{1}{16}$. Sutton 110, 110$\frac{1}{2}$.

On Friday, Bombay 5$\frac{1}{2}$, Brentford "A" 102, 102$\frac{1}{2}$, British Gas Light 118, 7 p.c. preference 123, Continental Union 28, Croydon maximum dividend 86, 86$\frac{1}{2}$, Gas Light and Coke 92$\frac{3}{4}$, 93, 93$\frac{1}{2}$, 93$\frac{3}{4}$, 93$\frac{7}{8}$, 4 p.c. preference 81, 81$\frac{1}{2}$, 82, Imperial Continental 152, 152$\frac{1}{2}$, 153, Primitiva 72, 1$\frac{3}{8}$d., Shrewsbury converted 77, South Metropolitan 99, 99$\frac{1}{2}$, 99$\frac{7}{8}$, 3 p.c. debenture 60, Swansea 7 p.c. preference 104, Wandsworth (Wimbledon), 112$\frac{1}{2}$.

Money continued in abundant supply in Lombard Street at the end of the week, being obtainable down to 1 p.c. at the close. Treasury Bills were placed at an average of £2 18s. 3·92d. p.ct., showing virtually no change on the previous week's rate.

Business in the Foreign Exchange Market was largely centred in the franc. Fresh purchases from Amsterdam were again generally believed to be on German account, and the price closed at 81.55. Belgian francs finished at 94$\frac{3}{8}$. Dutch florins closed at 11.55. Sterling was firmer, the New York rate rising to 4.31$\frac{7}{8}$.

There was little demand for silver at the commencement of the week, and the price declined in consequence. Later, owing to a cessation of selling, the price of bars hardened, but closed $\frac{1}{4}$d. per oz. for cash less than the previous week.

The Bank Rate is 4 p.c., to which it was raised from 3 p.c. on July 5 last. Bankers' deposit rates are 2 p.c. The deposit rates of the discount houses are 2 p.c. at call and 2$\frac{1}{2}$ p.c. at notice.

Issue.	Share.	When ex-Dividend.	Dividends. Prev. Hf.Yr.	Dividends. Last Hf. Yr.	NAME.	Quotations. June 13.	Rise + or Fall − on Week.	Transactions. Lowest and Highest Prices.
£			% p.a.	% p.a.				
131,978	Stk.	Feb. 7	5	5	Aldershot 5 p.c. max. C.	79—82	..	81
235,492	,,	,,	4	4	Do. 4 p.c. Pref.	70—73	..	..
1,551,868	,,	Apr. 3	5½	6	Alliance & Dublin Ord.	63—68	..	64½
374,000	,,	Jan. 10	4	4	Do. 4 p.c. Deb.	60—65	..	..
28c,000	5	May 22	8	8	Bombay, Ltd.	5—5½	..	5½—5⅝
100,000	10	Mar. 6	8½	8½	Bournemouth 5 p.c.	12½—13½	..	..
383,110	10	,,	7	7	Do. B 7 p.c.	12—13	..	..
115,000	10	,,	6	6	Do. Pref. 6 p.c.	11—12	..	..
50,000	Stk.	Dec. 28	3	3	Do. 3 p.c. Deb.	55—60	..	..
162,025	,,	,,	4	4	Do. 4 p.c. Deb.	75—80	..	..
992,045	,,	Feb. 21	6$\frac{1}{10}$	6$\frac{1}{10}$	Brentford A Con.	98—103	+1	99—102½
990,500	,,	,,	6½	6½	Do. B New	98—103	+1	..
76,000	,,	,,	5	5	Do. 5 p.c. Pref.	89—94	..	91—92½
306,690	,,	June 12	4	4	Do. 4 p.c. Deb.	75—80*	−1	..
181,337	,,	—	—	—	Do. 6 p.c. Rich. Red. Deb.	98—103	−2	..
214,740	,,	Mar. 6	11½	11½	Brighton & Hove Orig.	170—175	..	..
244,200	,,	,,	8½	8½	Do. A Ord.	124—127	..	..
1,287,500	,,	Feb. 21	5	5	Bristol 5 p.c. max.	92—93*a*	..	..
855,000	,,	Mar. 20	—	7	British Ord.	117—122	..	117½—118
100,000	,,	—	7	7	Do. 7 p.c. Pref.	120—125	..	123—123½
120,000	,,	Dec. 28	4	4	Do. 4 p.c. Red. Deb.	73—78	..	..
100,000	10	May 22	6	8	Cape Town, Ltd.	6½—7½	..	6½
100,000	10	Apr. 24	4½	4½	Do. 4½ p.c. Pref.	6—7	..	..
150,000	Stk.	Dec. 28	4½	4½	Do. 4½ p.c. Deb.	73—78	..	..
626,860	,,	Feb. 21	6	6	Cardiff Con. Ord.	99—102	+2½	..
237,860	,,	Dec. 28	7½	7½	Do. 7½ p.c. Red. Deb.	105—110	..	..
157,150	,,	Mar. 6	5	6½	Chester 5 p.c. Ord.	88—93*b*	..	..
1,513,280	,,	,,	6	6	Commercial 4 p.c. Cap.	90—95	..	91½—92½
560,000	,,	,,	6	6	Do. 3½ p.c. Cap.	90—95	..	91½
475,000	,,	June 12	3	3	Do. 3 p.c. Deb.	56—59*	−1	..
800,000	,,	14 Jan. 15	—	—	Continental Union, Ltd.	27—32	−1	27 28
200,000	,,	June 12	7	7	Do. 7 p.c. Pref.	75—80*	−3	..
660,000	,,	Mar. 6	6½	6½	Croydon sliding scale	101—104	..	..
284,975	,,	,,	5	5	Do. max. div.	83—86	..	86—86½
492,270	,,	Feb. 21	3	4½	Derby Con.	108—110*c*	..	..
55,000	,,	Jan. 12	4	4	Do. Deb.	74—76*c*	..	..
209,000	,,	Apr. 3	5	5	East Hull 5 p.c. max.	..	..	..
1,002,180	10	Jan. 24	5	2	European, Ltd.	6½—7½	..	6⅞
16,503,045	Stk.	Feb. 7	5⅛	5⅛	Gas Light & Coke 4 p.c. Ord.	93—95	−⅛	92⅜—94
2,600,000	,,	,,	3⅜	3⅜	Do. 3½ p.c. max.	62—63	..	62¼—63⅜
4,062,235	,,	,,	4	4	Do. 4 p.c. Con. Pref.	80—83	..	81—82
4,761,930	,,	June 12	3	3	Do. 3 p.c. Con. Deb.	60—63*	−1	62½—64
130,000	,,	Dec. 11	10	10	Do. 10 p.c. Bonds	..	..	195
42,000	,,	—	7½	7½	Do. 7½ p.c. Ilford Deb.	..	..	..
82,500	,,	Mar. 20	6⅜	6⅜	Hastings & St. L. 5 p.c. Conv.	91—96	..	..
258,740	,,	,,	5⅜	5⅜	Do. 3½ p.c. Conv.	76—81	..	..
70,000	10	May 8	10	10	Hongkong & China, Ltd.	16—17	..	..
86,600	Stk.	Mar. 6	9½	10	Hornsey 7 p.c.	143—148	..	..
1,976,000	,,	May 22	10	30	Imperial Continental Cap.	150—155	..	150½—153
401,400	,,	Feb. 7	3½	3½	Do. 3½ p.c. Red. Deb.	69—72	..	..
235,242	,,	Mar. 6	6½	6½	Lea Bridge 5 p.c. Ord.	95—100	..	..
2,127,340	,,	Feb 21	5½	5½	Liverpool 5 p.c. Ord.	91½—91½*b*	−½	91½
600,000	,,	Mar. 20	7	7	Do. 7 p.c. Red. Pref.	103—106*b*	..	105½
165,736	,,	Feb. 21	9	8	Maidstone 5 p.c. Cap.	124—129	..	..
63,480	,,	Dec. 28	3	3	Do. 3 p.c. Deb.	54—59	..	..
75,000	5	Dec. 13	7	5	Malta & Mediterranean	3⅜—3¾	..	..
50,000	100	Apr. 1	4½	4½	Met. of Melb'rne 4½ p.c. Deb.	..	..	..
541,920	Stk.	June 12	4	4	Montevideo, Ltd.	52—57*	−2	..
1,875,892	,,	Mar. 6	4⅝	5⅛	Newcastle & Gateshead Con.	84½—85½*d*	−½	..
250,166	,,	,,	4	4	Do. 4 p.c. Pref.	74—76*d*	..	..
529,705	,,	Dec. 28	3½	3½	Do. 3½ p.c. Deb.	71—73*d*	..	..
15,000	10	Mar. 6	11	11	North Middlesex 10 p.c.	16—17	..	..
75,940	10	,,	7$\frac{7}{10}$	7$\frac{7}{10}$	Do. 7 p.c.	11½—11¾	..	..
300,000	Stk.	May 8	9	7	Oriental, Ltd.	98—101	..	..
138,120	,,	Dec. 28	7⅞	7⅞	Plym'th & Ston'house 5 p.c.	115—120	..	..
60,000	50	Mar. 6	13	13	Portsea Island B	102—105	..	..
100,000	50	,,	12	12	Do. C	98—103	..	..
1,450,345	5	29 Oct. 14	—	—	Primitiva Ord.	..	..	7⅛
2,499,800	5	30 Dec. 15	—	—	Do. 5 p.c. Pref.	..	..	73⅛—73½
341,400	100	June 2	4	4	Do. 4 p.c. Red. Deb.	69—74	..	..
600,000	Stk.	Jan. 24	4	4	Do. 4 p.c. Red. Deb. 1911	54—57	..	..
220,335	,,	Dec. 28	4	4	Do. B. Aires 4 p.c. Rd. Db.	55—58	..	56
321,670	,,	,,	4	4	Do. R'r P'te 4 p.c. Rd. Db.	55—58	..	56—57
150,000	10	Mar 20	6	6	San Paulo 6 p.c. Pref.	6½—7	..	..
125,000	50	Jan. 2	5	5	Do. 5 p.c. Red. Deb.	39—41	..	..
270,000	Stk.	Mar. 20	5	5/8/1 4	Sheffield A	100—102*e*	..	..
419,968	,,	,,	5	5/8/1 4	Do. B	100—102*e*	..	..
1,047,000	,,	,,	5	5/8/1 4	Do. C	100—101*e*	..	..
90,000	10	June 12	6	8	South African	7—9*	..	7½
6,609,895	Stk.	Feb 21	5	6½	South Met. Ord.	99—101	..	98½—100
102,580	,,	Jan. 10	5	5	Do. Red Pref.	98—100	..	..
1,895,445	,,	,,	3	3	Do. 3 p.c. Deb.	58—61	..	60
734,000	,,	Mar. 6	6½	6½	Do. 6½ p.c. Red. Deb.	103—105	..	..
91,500	,,	,,	8½	8½	South Shields Con.	136—138*d*	..	..
1,087,795	,,	Feb. 21	6	6½	South Suburban Ord. 5 p.c.	100—105	..	104
368,837	,,	Dec. 28	5	5	Do. 5 p.c. Deb.	95—100	..	98½
647,740	,,	May 8	6	5	South'mpt'n Ord. 5 p.c. max.	84—87	..	..
121,275	,,	Dec. 28	4	4	Do. 4 p.c. Deb.	74—79	..	..
250,000	,,	Mar. 6	7	7	Swansea 7 p.c. Red. Pref.	103—105	..	104
200,000	,,	Dec. 28	6½	6½	Do. 6½ p.c. Red. Deb.	102—104	..	..
120,000	,,	Feb. 21	8	8	Tottenham District A 5 p.c.	119—124	..	..
882,275	,,	,,	6½	6½	Do. B 3½ p.c.	100—103	..	101
181,255	,,	June 12	4	4	Do. 4 p.c. Deb.	76—80*	−1	..
258,251	,,	Mar. 20	5	7/14/4	Tynemouth Con. and New	87—89*d*	..	..
					Wandsworth, Wimbledon, and Epsom—			
30,000	,,	Mar. 6	9	9½	Wandsworth A 5 p.c.	132—137	..	..
255,636	,,	,,	7½	7½	Do. B 3½ p.c.	110—115	..	..
108,075	,,	,,	6$\frac{9}{10}$	6/7/9	Do. C	96—101	..	..
240,865	,,	,,	6$\frac{9}{10}$	6/7/9	New Ordinary	..	..	97½
352,000	,,	,,	7⅛	7⅛	Wimbledon 5 p.c.	108—113	..	112½
98,000	,,	,,	7⅛	7⅛	Epsom 5 p.c.	115—120	..	..
88,416	,,	Dec. 28	3	3	5 p.c. Deb.	56—61	..	..

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